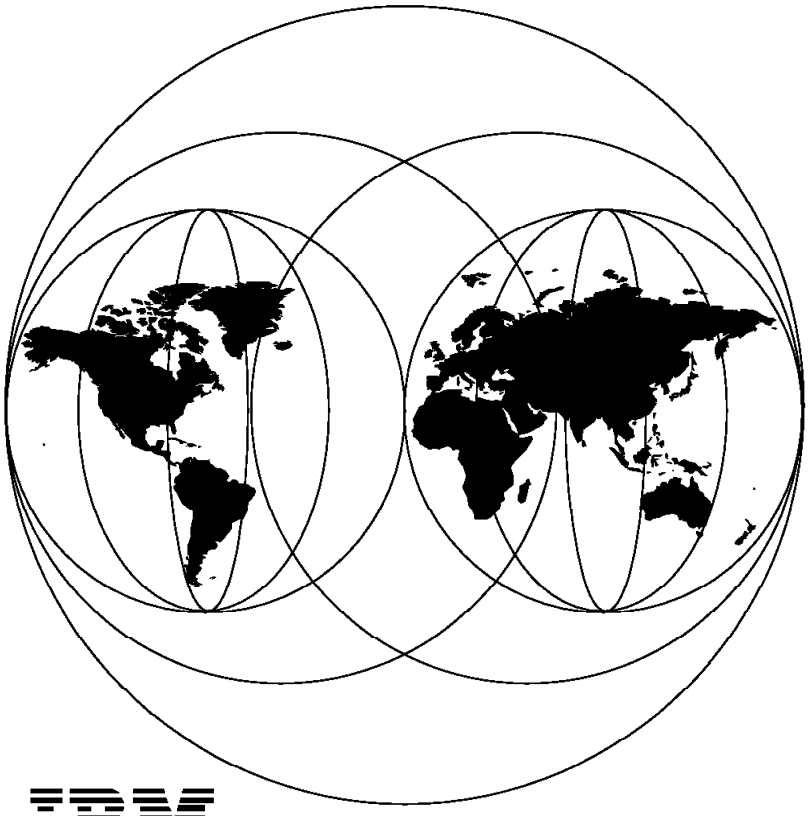
SG24-4817-00

IBM ATM Workgroup Solutions: Implementing the 8285 ATM Switch

December 1996



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Take Note!

Before using this information and the product it supports, be sure to read the general information in Appendix F, “Special Notices” on page 277.

First Edition (December 1996)

This edition applies to the ATM Workgroup Switch with microcode level 1.4.

Comments may be addressed to:
IBM Corporation, International Technical Support Organization
Dept. HZ8 Building 678
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Preface

This redbook provides a detailed overview of the IBM 8285 Nways ATM Workgroup Switch, from both functional and operational viewpoints. It provides everything you need to know to plan, implement, debug, manage, and maintain an ATM network using the 8285 switch. It includes scripted and tested configuration scenarios to simplify and expedite the initial implementation, and debugging and tuning guidelines to optimize the ATM network. In addition, it covers the very latest modules and features of the 8285/8260 family of ATM switches, including the ATM WAN Module, and the Video Distribution Module.

This book is intended for all networking personnel involved in planning, implementing, and/or maintaining an ATM network based on the IBM 8285 Nways ATM Workgroup Switch. A working knowledge of ATM is helpful but not necessary.

How This Redbook Is Organized

This redbook contains 296 pages. It is organized as follows:

- Chapter 1, “Introduction to ATM Networks”

  This chapter provides an overview of ATM, LAN Emulation, and Classical IP networks. This information provides a basis for understanding many of the operational aspects of the IBM 8285 Nways ATM Workgroup Switch.

- Chapter 2, “Introduction to the IBM 8285 Nways ATM Workgroup Switch”

  This chapter provides an overview of the major features of the IBM 8285 Base Unit and the IBM 8285 Expansion Chassis. This information will familiarize the reader with the overall layout and design of the 8285 switch

- Chapter 3, “Functional Overview of the IBM 8285”

  This chapter provides a detailed view of the functions of the 8285 switch and how it performs them. Included are details about the internal architecture, switching mechanisms (including an in-depth technical description of the switching process), control point codes, and the capabilities of the integrated Forum-Compliant LAN Emulation server.

- Chapter 4, “IBM 8285 ATM Modules”

  This chapter provides an overview of the many modules that can be installed with the 8285 switch. These modules provide performance and flexibility, and enable the 8285 switch to be used in a wide variety of network configurations.

- Chapter 5, “8285 ATM Network Specifications”

  This chapter provides an overview of the ATM capabilities specific to the 8285 switch. The overview includes discussions of which ATM features are supported, what the maximum system capabilities are, and how these capabilities might be implemented.

- Chapter 6, “IBM 8285 Planning and Installing”

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This chapter provides an overview of the 8285 installation process. This includes physical and logical planning information, as well as details about the 8285 microcode and how to upgrade it.

- Chapter 7, “IBM 8285 Configuration”

  This chapter provides information on how to configure and troubleshoot a network of 8285 switches. Both Classical IP ATM networks and LAN Emulation ATM networks are discussed. Actual console samples are included, where appropriate, to facilitate understanding.

- Chapter 8, “IBM 8285 Management”

  This chapter provides a discussion of how to manage an 8285 network using either an ASCII console or an SNMP-based network management platform. Various operational aspects are discussed as well.

- Appendix A, “ 8285 ATM Control Point Commands”

  This appendix provides an overview of the 8285 console, its functions, and its supported commands.

- Appendix B, “Pinouts for Ports and Cables”

  This appendix provides pin-out diagrams for the ATM25 RJ-45 ports.

- Appendix C, “Part Numbers for Key Components”

  This appendix contains a list of components and part numbers.

- Appendix D, “Hints and Tips for the ATM 4-Port TR/Ethernet Bridge Module”

  This appendix contains information concerning the latest release of code for the ATM 4-Port TR/Ethernet Bridge Module.

- Appendix E, “ IBM ATM Campus Switch Private MIBs”

  This appendix contains the latest version of the IBM campus ATM switch private MIB.

The Team That Wrote This Redbook

This redbook was produced by a team of specialists from around the world working for the Systems Management and Networking ITSO Center, Raleigh.

This project was designed and managed by **Georges Tardy**, LAN Campus Specialist at the Systems Management and Networking ITSO Center, Raleigh, working in La Gaude, France. He joined IBM in 1965, and was previously a hardware development engineer of campus hub products at La Gaude Laboratory, France.

The authors of this document are:

Marc Fleuette is a Senior Networking Technical Specialist from the IBM North American Sales and Services organization. He has been with IBM for nine years, in both marketing and technical positions, including two years as Technical Internetworking Marketing Specialist. He currently provides pre-sales technical support for IBM′s family of campus internetworking products, including hubs, routers, and switches, for both ATM and traditional LANs. He has a B.S. in Industrial Engineering and a B.A. in History/English, both from Lehigh University in Bethlehem, PA, USA.

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Tadashi Murayama is an Advisory Networking I/T Specialist in IBM Japan. He has been with IBM Japan for 11 years in the Field Support Organization and has been in charge of the networking products, such as the CCU/NCP and the LAN products. He holds a degree in LL.B. from Gakusyuin University in Tokyo, Japan. His areas of expertise include traditional SNA networking, legacy LAN protocols (token-ring, Ethernet, FDDI), and campus ATM protocols and related products.

Thanks to the following people for their invaluable contributions to this project:

Aroldo Yuji Yai
Systems Management and Networking ITSO Center, Raleigh.

Ange Aznar
IBM La Gaude

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Benoit Panier
Michel Leblais
Pierre-Olivier Martin
Olivier Caillau
Bernard Putois
Jacques Baroghel
Eric Montagnon

Comments Welcome

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Chapter 1. Introduction to ATM Networks

This book is designed to help you to get the most effective use of the IBM 8285 Nways ATM Workgroup Switch as you implement an ATM network. Before going into further details about the 8285, however, it might be useful to review the basics of ATM networking, addressing, and data flows.

1.1 ATM Fundamentals

Asynchronous Transfer Mode (ATM) is a high-performance network technology that is rapidly becoming the standard for high-speed LAN and WAN networks, both public and private. It combines the flexibility and resiliency of connection-less protocols, such as TCP/IP, with the efficiency and manageability of session-oriented protocols, such as SNA. This is because ATM uses small, fixed-size packets called *cells* which are transported across the network hop-by-hop along a pre-determined *virtual path* that can be quickly changed to avoid congestion or failures. Both of these concepts are discussed below.

1.1.1 ATM Cells

ATM uses the concept of cells as its basic delivery vehicle. These cells are similar to the packets (or frames) used in traditional networks, except for two distinguishing features:

1. Fixed Cell Size

   All ATM cells are 53-bytes long, of which 48 bytes are payload, and 5 bytes are header information. This payload-size provides the best combination of efficiency (favoring large payloads for data) and latency (favoring small payloads for time-sensitive applications such as voice and video).

   The header contains all the information necessary for the cell to enter the network, to be carried to its next (intermediate) destination, and to identify simple errors (single-bit) that might occur.

   The most important thing about the fixed cell size, however, is that it enables cells to be switched simply and efficiently, in hardware, without costly (in time and money) large buffers.

2. Minimal Routing Information

   ATM cells are connection-oriented, which means that they are not responsible for identifying a destination or determining the best route. In fact, the only routing information necessary is the current hop information (which the next switch uses in its forwarding decision). And, since all cells for a given session follow the same path, no provision is necessary for out-of-sequence arrival. Thus, unlike traditional LAN packets, sequencing numbers are not required, and addressing at the MAC and network layers is eliminated (for native ATM applications). The result is more data, less overhead, and simpler hardware-based switching

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1.1.2 ATM Connections

ATM, being session-oriented, requires that a path through the network be determined and maintained for the duration of the session. This path is comprised of *virtual channel links* (switch-to-switch connections), which are linked together to form a *virtual channel connection* (VCC) (end-to-end connection), which are aggregated into *virtual paths* (VP). Just like a virtual channel (VC), a virtual path can be a *virtual path link* (switch-to-switch connection) or a *virtual path connection* (VPC) (end-to-end connection). More importantly, a virtual path can be switched to a new route (to avoid congestion or a failure) without affecting or individually processing the VCs it contains.

Connections through the network can be either fixed and pre-determined, or can be defined dynamically through a signalling protocol. A pre-determined path, defined by the network operator, is called a *permanent virtual connection* (PVC), while a dynamically determined temporary path is called a *switched virtual connection* (SVC). In either case, a connection will be implemented only if there is adequate capacity in the network to meet the requisite end-to-end bandwidth and Quality of Service (QoS) parameters, or if an existing connection can be preempted to make it possible to meet bandwidth and QoS requirements.

1.1.3 ATM Addressing

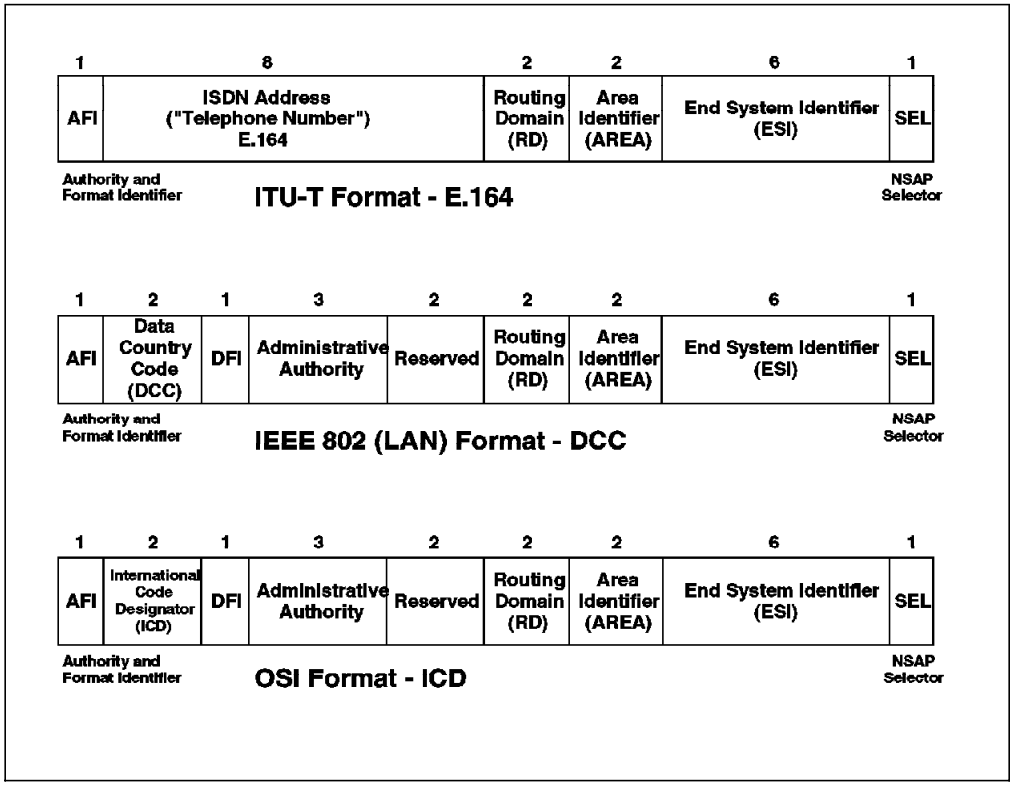

Figure 1. ATM Addressing Format Cell

An ATM address consists of two parts: a 13-byte network prefix and a 7-byte terminal identifier (consisting of a 6-byte *end station identifier* (ESI), and a 1-byte *selector* field). Further information on specific requirements for ATM addressing can be found in *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide* and in ISO-8348 (CCITT X.213). Of specific relevance to us, are the following addressing restrictions:

1. The network prefix must be unique and consistent within a given ATM network. It is defined at each switch in the network and consists of an 11-byte network address and a 2-byte area identifier, which is further divided in to a 1-byte *ATM Cluster Number*(ACN), and a 1-byte *Hub Number* (HN). This results in a hierarchical network topology of:

   a. An ATM network comprised of

   b. ATM sub-networks (or clusters) comprised of

   c. ATM hubs

   In any given ATM network, all switches will have an ATM address with the same first 11 bytes. In any given ATM cluster, all switches will have an address with the same first 12 bytes, and every switch will have a unique 13-byte network prefix.

   This hierarchical organization allows for very efficient topology calculation and distribution, since updates can be localized to a given cluster, or, where appropriate, to devices connected to an adjacent cluster or network.

2. The network prefix must begin with either 39 (corresponding to IEEE 802 (LAN) Format), 45 (corresponding to ITU-T (E.164) Format), or 47 (corresponding to OSI Format). Generally speaking, it doesn′t matter which format you choose, however, specific bytes have specific significance in each format, and, consequently, care should be taken in choosing a format, especially if your ATM network will be connected to other ATM networks.

1.1.4 ATM Data Flows

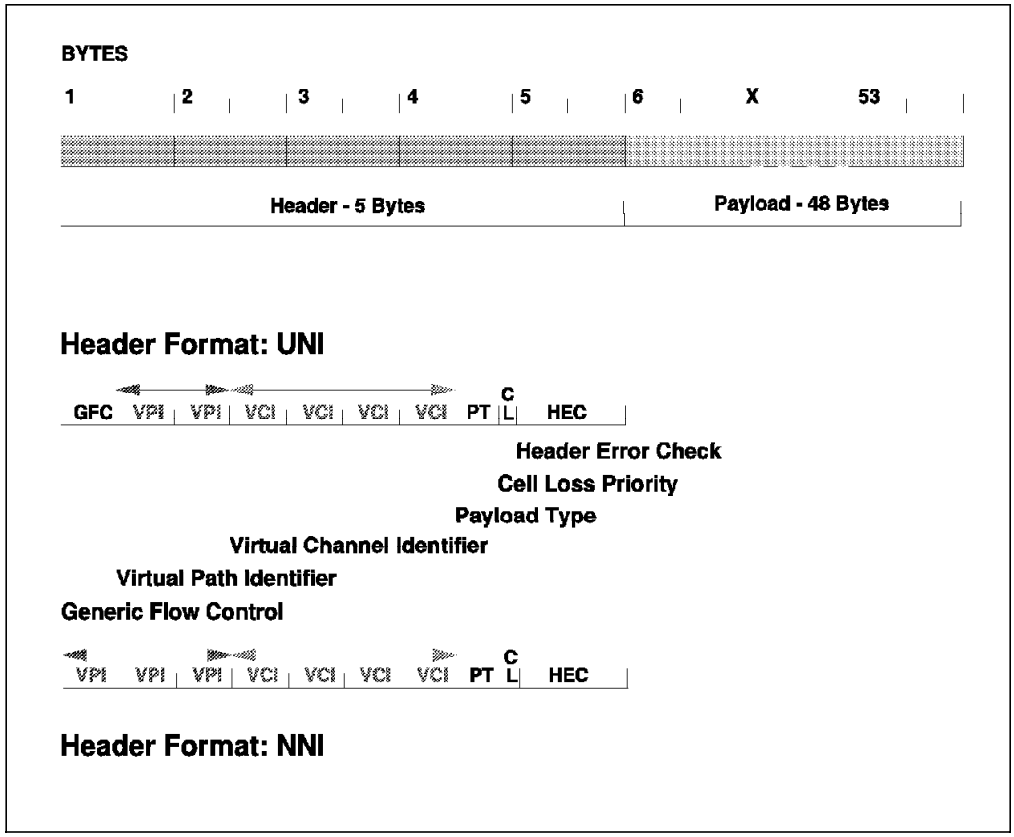

Figure 2. ATM UNI/NNI Format Data Cells

Because ATM allows for dynamic registration of resources, signalling processes have been established to provide for initial registration, connection setup, and connection teardown, whether the connection is native ATM, ATM Forum-Compliant LAN Emulation, or Classical IP (CIP).

1.1.4.1 Basic ATM Signalling

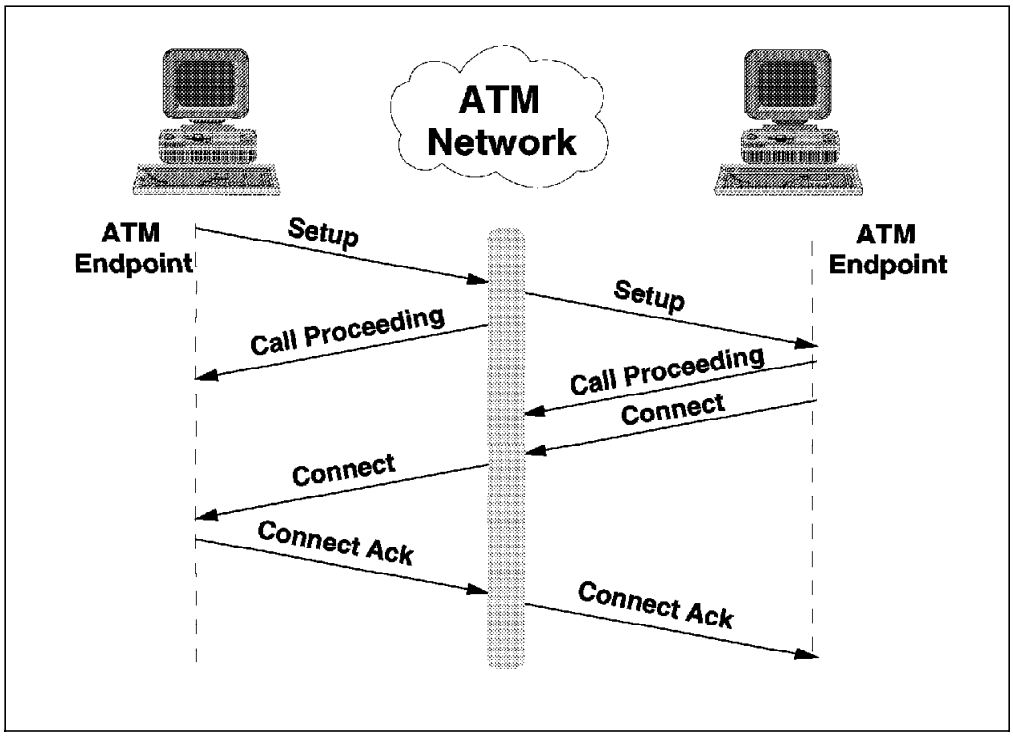

Figure 3. ATM Call Establishment

For an endstation to communicate in a switched environment such as ATM, it must register with the network, request a connection when necessary, and clear the connection when through. For native ATM endstations, this is done by the following:

Initial Registration: When an endstation wishes to enter the network, it must first register its full ATM address with its associated switch. This signalling process is described in ATM UNI Specification 3.0 (based on ITU-T Q.93B recommendations), or more recently, in ATM UNI Specification 3.1 (based on ITU-T Q.2931 recommendations) and is performed when the endstation is activated. During this process, the workstation receives its 13-byte network prefix from the switch, appends its own local address (ESI plus selector), and registers its complete ATM address with the switch.

Connection Setup: When an endstation wishes to communicate with another endstation, it must first establish a connection to it. It does this by issuing a SETUP request to the ATM network.

If the requested address is local, the switch acknowledges the request by issuing a CALL PROCEEDING response to the requesting endstation and forwarding the SETUP request to the requested endstation, which acknowledges receipt with a CALL PROCEEDING response.

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If the requested endstation is not local, the switch will forward the request to the correct switch based on routing information compiled and maintained by the 8285 ATM Control Point′s Topology and Routing Services (TRS) subsystem. The path will be selected based on the *widest* path (not the *shortest*) available between the end-points. This path information is appended to the setup request and is used by intermediate switches to determine the next hop through the network. There can be no more than 15 hops in any given path.

If the requested workstation is able to accept the incoming connection, it issues a CONNECT response to the network, which forwards it back to the requesting workstation, where it is acknowledged by issuing a CONNECT ACK response to the network which forwards it to the destination endstation to complete the call set-up process.

Connection Tear-Down: When an endstation wishes to end a connection, it issues a DISCONNECT request to the network. The network acknowledges the request by returning a RELEASE response (instructing the requesting endstation to drop all resources associated with the call), and by forwarding the DISCONNECT on to the destination workstation, which acknowledges the request by returning a RELEASE command to the network. The process is completed when the requesting endstation returns a RELEASE COMPLETE to the network, which forwards it to the destination endstation, indicating that the call has been dropped and the associated resources freed up.

1.1.4.2 ATM Forum-Compliant LAN Emulation (LANE)

LAN emulation simplifies a migration from a traditional LAN environment to an ATM switched environment by superimposing LAN interfaces on top of the underlying ATM transport and by supporting traditional LAN addressing (at the media access control (MAC) layer) as well as broadcast and multicast capabilities. This means that LAN-based applications run unchanged, yet now have access to to the network and to network-attached resources at scalable speeds from 25 Mbps to 155 Mbps and beyond.

The signalling process used by LANE is analogous to that for basic ATM signalling, except that instead of a control point providing directory services, there is now a LAN Emulation Server (LES) which provides directory services at the MAC layer (which provides MAC address to ATM address mapping) for LAN Emulation Clients (LECs). The 8285 ATM Control Point has two LES entities, which together can handle 128 clients, distributed between two Ethernet or token-ring ELANs. Either of the 8285 ATM Control Point′s two LECs can use these internal LESs or can be configured to use an external LES, such as the IBM Multiprotocol Switched Services Server, providing for greater flexibility, for larger ELANs, and for inter-ELAN routing and bridging.

Emulating a traditional LAN environment requires the ability to allow for broadcast traffic (common in a connectionless environment), while handling it in a fashion optimized for a connection-oriented environment. This function is addressed by the Broadcast/Unknown address Server (BUS), which attempts, with the LES, to convert MAC broadcast traffic to a specific ATM destination address. The 8285 ATM Control Point integrates this BUS function with the internal LES function. Either of the 8285 ATM Control Point′s two LE clients can also be configured to use an external BUS, such as the IBM Multiprotocol Switched Services Server, providing for very sophisticated broadcast management, especially in IP and IPX environments.

To avoid having to configure the LES's address at each endstation, LANE provides for a Lan Emulation Configuration Server (LECS), which LECs can query for their proper LES address. This enables backup LESs to be configured, since should the primary LES fail, the LECS merely has to direct connections to a backup LES without having to change any configuration in the workstation. Although the 8285 ATM Control Point does not contain an LECS, either or both of the internal LECs can be configured to use an external LECS, such as that provided by the IBM Multiprotocol Switched Services Server.

This section was intended only as an overview of LANE. For a more detailed description of these functions, please see *IBM 8260 As a Campus ATM Switch*, SG24-5003 and *ATM Campus Introduction, Planning, and Troubleshooting Overview*, GA27-4089.

1.1.4.3 Classical IP (CIP)

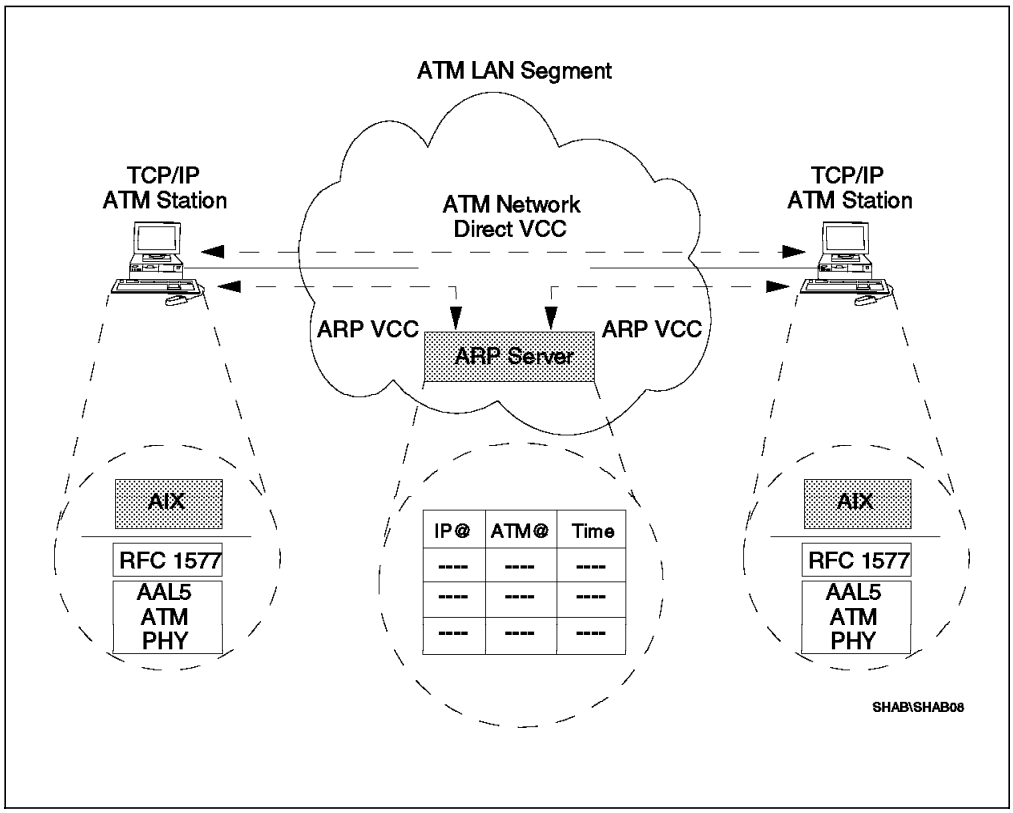

Figure 4. ATM Classical IP using ARP Server

Classical IP (RFC 1577) is a protocol-specific VLAN (PVLAN) technology that has been widely adopted in the Internet working community. It provides for layer 3 routing of IP datagrams over an ATM network. In many ways, it is analogous to LANE. For instance, all endstations must register with an address resolution server (called a LES in LANE, but an *Address Resolution Protocol (ARP) Server* in CIP). Once the endstation is registered with the address resolution server, it is, by definition, part of a virtual broadcast domain (an ELAN in LANE terminology, but a VLAN in CIP, known as a *Logical IP Subnet* (LIS)). The 8285 ATM Control Point has a single CIP client entity.

Here are the CIP data flows:

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CIP Address Registration: Because in CIP there is no function analogous to the LECS in LANE, each endstation must be configured with the ATM address of its ARP server. The ARP client establishes a connection to the ARP server, and notifies it of its IP address and its ATM address. The ARP server adds these to its ARP table, so that it can respond properly to other ARP requests.

CIP Address Resolution: When a CIP client wishes to establish IP communication with another IP device, it issues an ARP to the ARP server to determine the ATM address of the other device. If the ARP server has an entry that matches the IP address of the requested device, it returns the ATM address of that device to the requesting endstation, which caches it in its own ARP table. If however, the ARP server doesn′t have the IP address in its ARP table, it returns an ARP_FAILURE to the requesting client. The client now forwards the unresolvable address to its default gateway for further handling. If the gateway can resolve the address, it returns its IP and ATM addresses to the client to be cached. If the gateway cannot resolve the address, it returns an ARP_FAILURE to the client and the address resolution process terminates.

CIP Data Forwarding: When a device wishes to forward data to another CIP device, it must first check to see if it knows the other device′s ATM address (that is, its ARP table contains an entry for the desired destination device). If so, it merely establishes a direct connection with the other device, and forwards data to it. If not, it must first resolve the address (see “CIP Address Resolution” above), then setup a connection, and then forward data directly.

A more complete discussion of Classical IP can be found in *IBM 8260 As a Campus ATM Switch*, SG24-5003 and *ATM Campus Introduction, Planning, and Troubleshooting Overview*, GA27-4089.

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Chapter 2. Introduction to the IBM 8285 Nways ATM Workgroup Switch

The IBM 8285 Nways ATM Workgroup Switch (hereafter called the 8285 switch) is an ATM switch for the workgroup environment that provides a low-cost ATM solution as either a stand-alone switch or as an access node to the rest of the enterprise. Using your existing wiring it provides up to 25 Mbps of bandwidth to users. The 8285 switch can connect users to any ATM network at speeds up to 155 Mbps, and even has forum-compliant LAN emulation built-in to make implementation easier.

In addition, the IBM 8285 Nways ATM Workgroup Switch is expandable, using the optional 8285 expansion chassis which enables it to take advantage of most of the many ATM modules available for the IBM 8260 Nways Multiprotocol Switching Hub. This provides you with ability to:

- Create even larger workgroups
- Service more high-speed devices (such as servers)
- Provide more bandwidth in to your ATM backbone network
- Connect existing token-ring or Ethernet users directly to the ATM backbone
- Connect to remote sites using public ATM services at speeds from 34 Mbps up to 155 Mbps
- Distribute video information across your ATM network and make it accessible using standard TV monitors

The following sections provide an overview of the 8285 switch.

2.1 8285 Components

The 8285 switch is comprised of the following components:

- Standard:
  - Base Unit:
    - 12 ATM 25.6 Mbps ports
    - I/O slot for optional uplink (see below)
- Optional:
  - 155 Mbps ATM I/O Card which can be installed in the IBM 8285 Base Unit:
    - Multi-mode Fiber (MMF)
    - Single-mode Fiber (SMF)
  - Expansion Unit
  - Installable 8285/8260 ATM Modules

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Note

Although there are two models of the 8285 switch, the 8285-00B and the 8285-00P, they are identical except that the latter includes 12 workstation adapters, providing a total solution at a special bundled price.

2.2 Base Unit

The base unit is comprised of the following:

- Internal Features:
  - An ATM cell switching function
  - A switch control function, called the 8285 ATM Control Point
- Front Panel Features:
  - Ports:
    - 12 ATM ports that support ATM 25.6 Mbps operation over standard copper wiring
    - A slot for an optional high-speed uplink to provide 155 Mbps access to either a server or to an ATM backbone
  - LEDs:
    - System Status
    - Port Status
  - Connectors:
    - A connector to connect the optional expansion unit
    - A connector to connect a standard ASCII console

2.2.1 Internal Features

The IBM 8285 Base Unit contains a planar which controls the 8285 switch and its external interfaces.

2.2.1.1 ATM Cell Switching in the IBM 8285 Base Unit

The ATM switching mechanism installed in the base only switches ATM cells between ports in the base unit. This is accomplished by basically taking what would normally be the backplane output and connecting it directly to what would normally be the backplane input.

When an IBM 8285 Expansion Chassis is connected to the IBM 8285 Base Unit, however, this connection is disabled, and the traffic from the IBM 8285 Base Unit uses the switch-on-a-chip that is incorporated in the IBM 8285 Expansion Chassis.

2.2.1.2 8285 ATM Control Point

The 8285 ATM Control Point is integrated in the base unit and provides the following functions:

- Manages the functions of the IBM 8285 Base Unit as well as the optional 8285 Expansion Chassis and its inserted modules.

- Controls the ATM cell switching between appropriate ports and performs the functions associated with the establishment and management of ATM circuits.
- Provides a management interface (via an SNMP manager or an ASCII/TELNET terminal) for monitoring, configuration, and microcode distribution.
- Provides an Forum-Compliant LAN Emulation implementation which supports:
  - Integrated LAN Emulation Server (LES)/Broadcast and Unknown Server (BUS)

    There are two instances of the LES/BUS in the 8285 ATM Control Point, allowing up to two Emulated LANs (ELANs), either token-ring or Ethernet, to be configure.
  - Integrated LAN Emulation Client (LEC)

    There are two instances of the LEC configurable in the 8285 ATM Control Point, allowing the 8285 ATM Control Point to be accessible from up to two ELANs, either token-ring or Ethernet.
  - LAN Emulation Configuration Server (LECS)

    Although the LECS function is not integrated in to the 8285 ATM Control Point, support is provided for using an external LECS by using its well-known address, or by getting its ATM address through the ILMI protocol.

2.2.2 8285 Front Panel

Figure 5 shows the front panel of the IBM 8285 base unit.

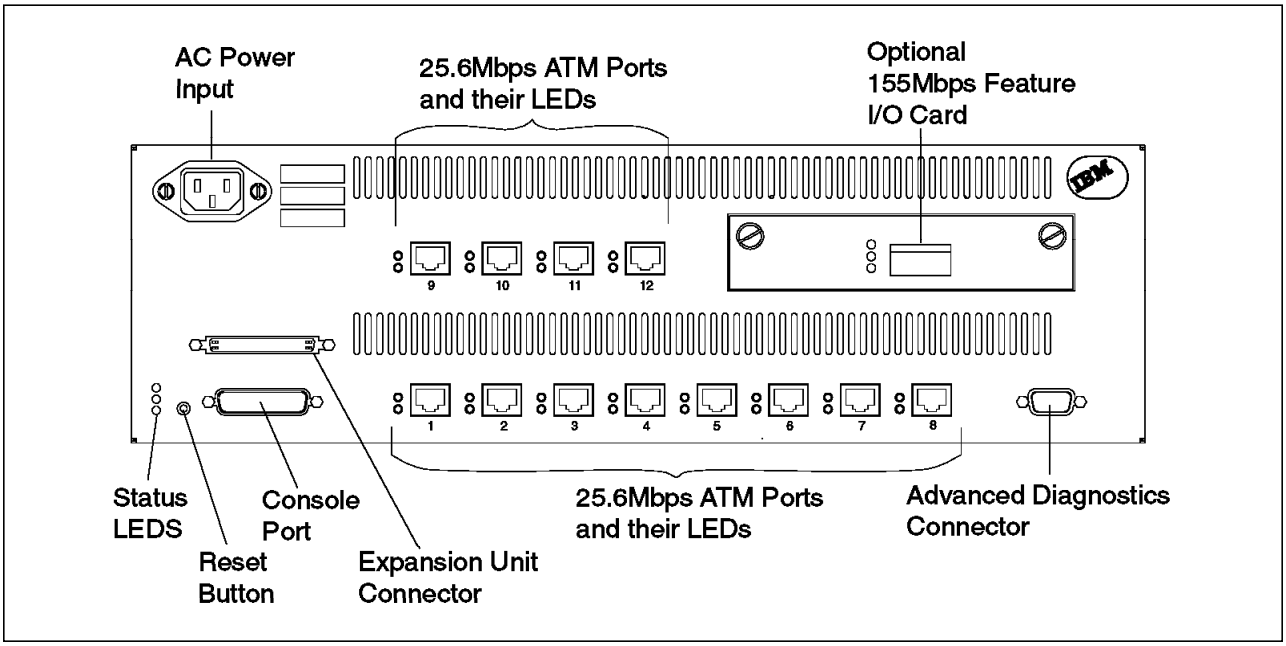

Figure 5. Front Panel of the IBM 8285 Nways ATM Workgroup Switch Base Unit

As found in the Figure 5, there are ports, LEDs, connectors and a button that the user can access from the front panel.

2.2.2.1 Ports

The IBM 8285 Base Unit has the following ATM ports:

- 12 ATM25 Ports
  - Fully compliant with the *ATM Forum Physical Interface Specification for 25.6 Mbps over Twisted Pair Cable*
  - Use standard RJ-45 connectors
  - Support standard twisted pair cabling, either shielded or unshielded
- 1 ATM155 Port (Optional):

  This port is further described in 2.2.3, “155 Mbps ATM I/O Card” on page 13.

2.2.2.2 LEDs

The front panel has LEDs for two purposes:

1. Port LEDs:
   - Port Enable
   - Output Activity
2. Switch Status LEDs:
   - Power
   - OK
   - Fault

2.2.2.3 Connectors

The front panel has four connectors:

- Power Input

  The power input connector matches the country-specific power cord that is shipped with the base unit. The power supply itself is an auto-sensing universal power supply.
- Console Port

  The console port is a standard RS-232 25-pin D-shell male interface for connecting either an ASCII console or a modem in order to perform the initial configuration.
- Expansion Connector

  The expansion connector is a 68-pin female connector used to attach the IBM 8285 Expansion Chassis using an expansion interface cable shipped with the IBM 8285 Expansion Chassis shipping group.
- Advanced Diagnostics Connector

  The advanced diagnostics connector is a 9-pin connector used only by authorized service personnel for advanced diagnostics. This connector is not needed in any case to install and configure the 8285 switch.

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2.2.2.4 Reset Button

The reset button resets both the IBM 8285 Base Unit and the optional IBM 8285 Expansion Chassis with its inserted modules.

For more information about the LEDs, the connectors, and the reset button, refer to the *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381.

2.2.3 155 Mbps ATM I/O Card

The 155 Mbps ATM I/O Card is an optional card installable in the 155 Mbps Feature I/O Card Slot of the base unit. There are two types of 155 Mbps ATM I/O Cards available, Multimode Fiber (FC 5500) and Single-Mode Fiber (FC 5501). It becomes the 13th port of base unit and can be linked to an ATM station or to another ATM switch that supports ATM 155, such as another 8285 switch or an 8260 hub.

2.2.3.1 Connectors

Both I/O cards have SC connectors.

2.2.3.2 LEDs

The 155 Mbps ATM I/O Card has the following LEDs:

- Status
- Output Activity
- Error

2.3 Expansion Unit (FC 5502)

The 8285 Expansion Chassis provides three slots to receive IBM 8260/8285 ATM modules, extending the 8285 switch's functions and capacities.

The IBM 8285 Expansion Chassis consists of the following:

- Internal Features:
  - An ATM backplane that is similar to the one used in the 8260 hub.
  - A planar containing a switch-on-a-chip, which connects the base unit ATM ports to each other and to other ATM modules in the IBM 8285 Expansion Chassis.
- External Features:
  - Slots
  - Connectors
  - LEDs
  - A rack-mountable chassis with an integrated, auto-sensing universal power supply

2.3.1 Internal Features

The IBM 8285 Expansion Chassis has two primary internal features.

2.3.1.1 ATM Backplane

The IBM 8285 Expansion Chassis contains an ATM backplane that is effectively a three-slot version of the 8260 hub's ATM backplane. That is to say, it is a completely passive backplane with female connectors. It is capable of supporting most 8260 hub ATM modules.

Note

However, there are some differences between the ATM backplanes of the IBM 8285 and IBM 8260. Specifically, the IBM 8260 ATM Control Point and Switch Module cannot be used in the IBM 8285 Expansion Chassis. For more information, refer to Chapter 3, "Functional Overview of the IBM 8285" on page 17.

2.3.1.2 ATM Planar

The IBM 8285 Expansion Chassis contains a planar which has a switch-on-a-chip switching module. When connected to the IBM 8285 Base Unit with the expansion interface cable, the switch-on-a-chip performs all the port-to-port cell switching:

- Between ports in the IBM 8285 Base Unit
- Between ports in the IBM 8285 Base Unit and ATM modules in the IBM 8285 Expansion Chassis
- Between ports on ATM modules in the IBM 8285 Expansion Chassis

2.3.2 Front Panel

Figure 6 shows the front panel of the IBM 8285 expansion unit.

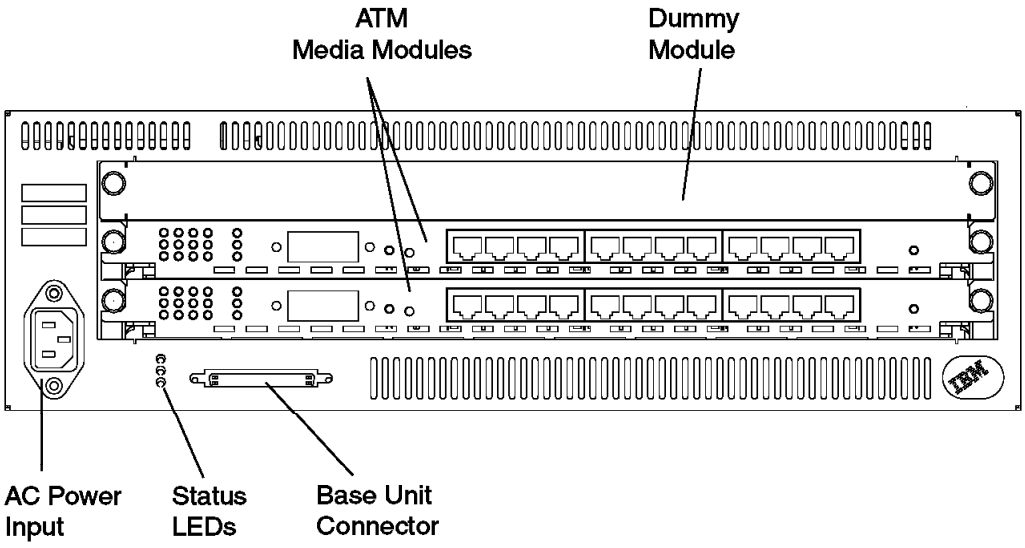

Figure 6. Front Panel of the IBM 8285 Nways ATM Workgroup Switch Expansion Unit

As shown in the Figure 6, there are slots, LEDs, and connectors that the user can access from the front panel.

2.3.2.1 Slots

The expansion unit has three slots that can support most of the IBM 8260 ATM modules. The modules that are supported in the IBM 8285 Expansion Chassis are listed in Chapter 4.

Figure 7 shows how the modules are inserted in the IBM 8285 Expansion Chassis.

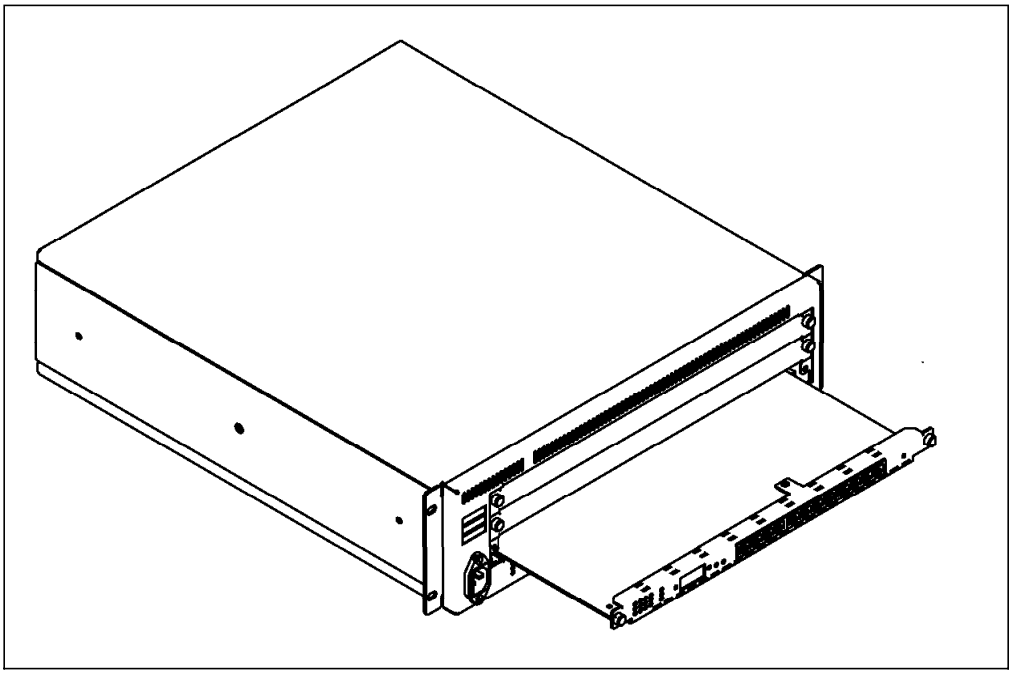

Figure 7. Inserting a Module in the Expansion Unit

2.3.2.2 LEDs

The expansion unit has the following switch status LEDs:

- Power
- OK
- Fault

2.3.2.3 Connectors

The expansion unit front panel has two connectors:

- Power Input
- Base Connector

  The base unit connector is a 68-pin female connector just like expansion unit connector of the base unit. It is connected to the IBM 8285 Base Unit by the expansion interface cable which is shipped with the expansion unit.

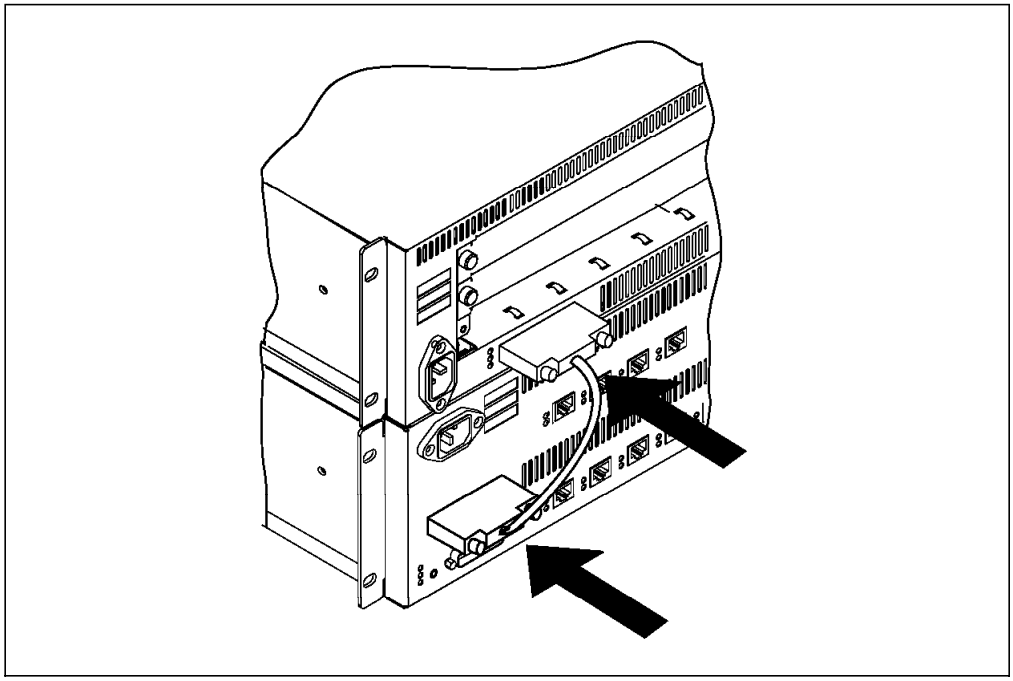

Figure 8. Attaching the Expansion Interface Cable

For more information about the LEDs and the connectors, refer to the *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381.

2.4 Installable Modules

All ATM modules designed for the IBM 8260 Nways Multiprotocol Switching Hub can be used in the IBM 8285 Expansion Chassis. Refer to 4.1, "Modules Currently Available for the 8285 ATM Subsystem" on page 35 for the list of modules that are officially supported with the 8285 switch.

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Chapter 3. Functional Overview of the IBM 8285

This chapter contains the following sections describing the functional overview of the IBM 8285:

- IBM 8285 Architecture Overview
- Switching Fabric
- Control Point Codes
- ATM Backplane / Expansion Unit Connection
- LAN Emulation Server Functions

3.1 IBM 8285 Architecture Overview

This section discusses the architecture of the IBM 8285.

Figure 9 on page 18 shows the hardware architecture of the IBM 8285 Base Unit.

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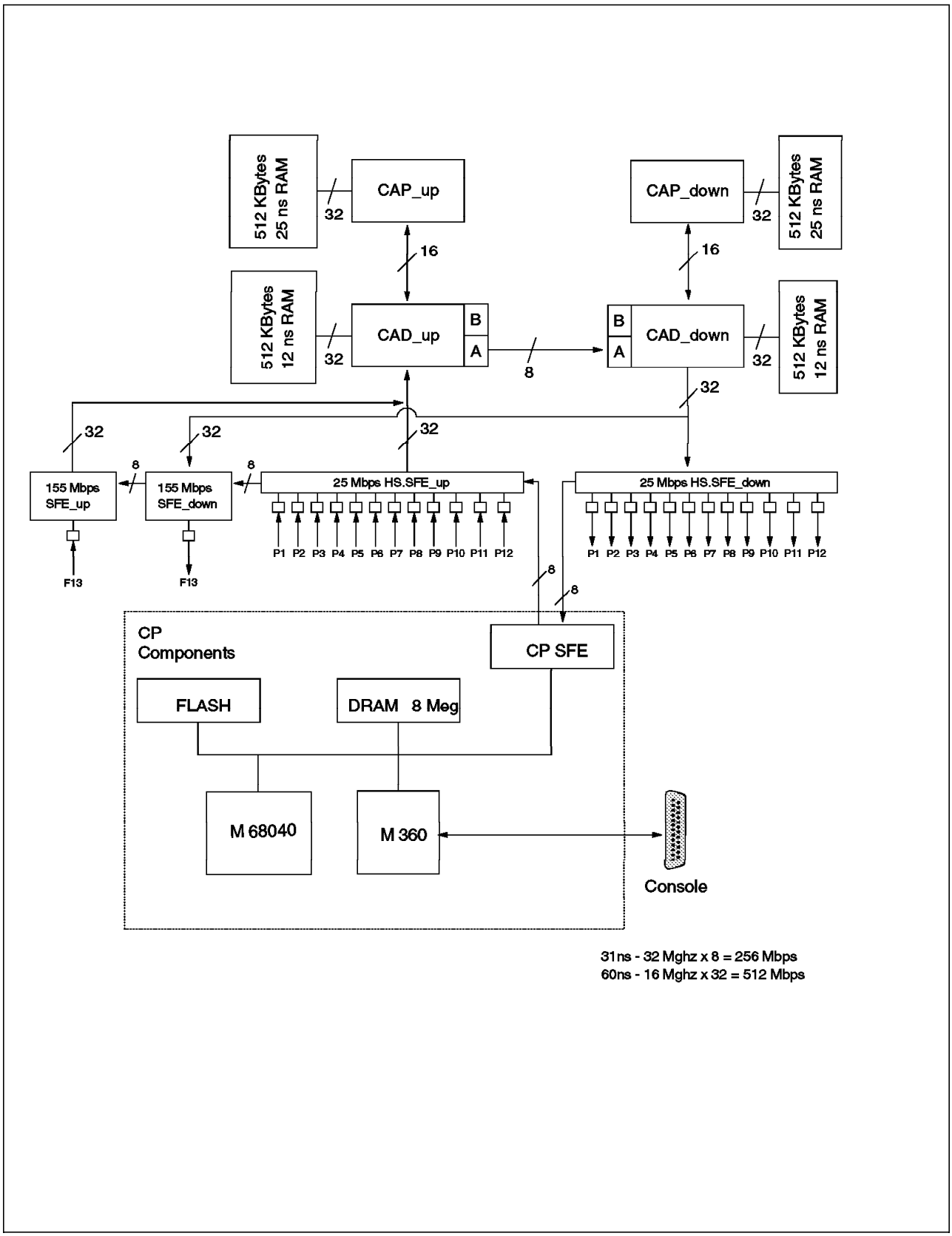

Figure 9. Hardware Architecture of the IBM 8285 Nways ATM Workgroup Switch Base Unit

As shown above, the IBM 8285 Base Unit contains the following functional components:

- Management and Control Components:
  - Control Point components:
    - Processing Components
      - Flash memory, to store the microcode
      - 8M byte DRAM, for operational code and tables
      - Motorola M68040 processor, to execute the microcode
    - Management Components:
      - M360 processor, to handle the console interface (the same as the IBM 8260)
- Data Handling Components:
  - CAP/CAD components to process cells, both inbound and outbound
  - Specific Front End (SFE) components to handle the physical interfaces, inbound and outbound, for all ATM ports, including:
    - ATM 25 Mbps ports
    - ATM 155 Mbps port. While this SFE is physically located on the optional 155 Mbps ATM I/O Card, it can be treated as functionally part of the base unit.
    - ATM control-point port.

3.1.1.1 8285 ATM Control Point

The 8285 ATM Control Point has a processor and flash memory. The flash memory holds the boot strap code and also the operational code. The control point performs the following functions:

- Signalling entities
- Resource management
- Address mapping
- Topology and route selection
- Node management and inband or out-of-band console interface
- Integrated LES/BUS

The control point manages the rest of the ATM subsystem by sending control cells via an internal port connected to the 25 Mbps HS.SFE.

3.1.1.2 CAP, CAD and SFE

The CAP, CAD and SFE are internal components implemented on the IBM 8285 Base Unit, as well as in each of the ATM modules. Their functions are as follows:

- CAP/CAD Components:
  - **CAP (Common ATM Processor)**

    The CAP handles the cell routing, queuing, scheduling, and traffic management. It determines what the routing header for the internal cell should be and gives the information to the CAD to build the cell.
  - **CAD (Common ATM Datamover)**

The CAD function prepares the cell for transmission to the switch. The CAD builds the internal cell in its RAM according to instructions given by the CAP.

As described in 3.1, “IBM 8285 Architecture Overview” on page 17, the IBM 8285 base unit is treated as a single module and all ports in the base unit share two sets of CAP/CAD, one set to handle the inbound cells, called CAP_up and CAD_up, and the other set to handle the outbound cells, called CAP_down and CAD_down.

- **SFE (Specific Front End)**

  The SFE handles the ATM front-end concentration and dispatch. Its main role is to deliver the cell from any ATM interface to the CAD.

  There are three sets of SFE components in the base unit: an inbound/outbound pair for the ATM25 ports, called HS.SFE_up/HS.SFE_down, an inbound/outbound pair for the ATM155 port, called SFE_up/SFE_down, and a single, bidirectional SFE used by the control point, called the CP SFE.

In addition, each ATM module also uses CAP, CAD, and SFE components, but in two sets: an inbound set (CAP_Up, CAD_Up, and SFE_Up), and an outbound set (CAP_Down, CAD_Down, and SFE_Down). Note that this slightly different from the 8285 switch which has the additional CP SFE, and which connects CAD_up directly to CAD_down when operating without an expansion unit.

Figure 10 on page 21 shows the hardware architecture of the IBM 8285 Base Unit when connected to the IBM 8285 Expansion Chassis.

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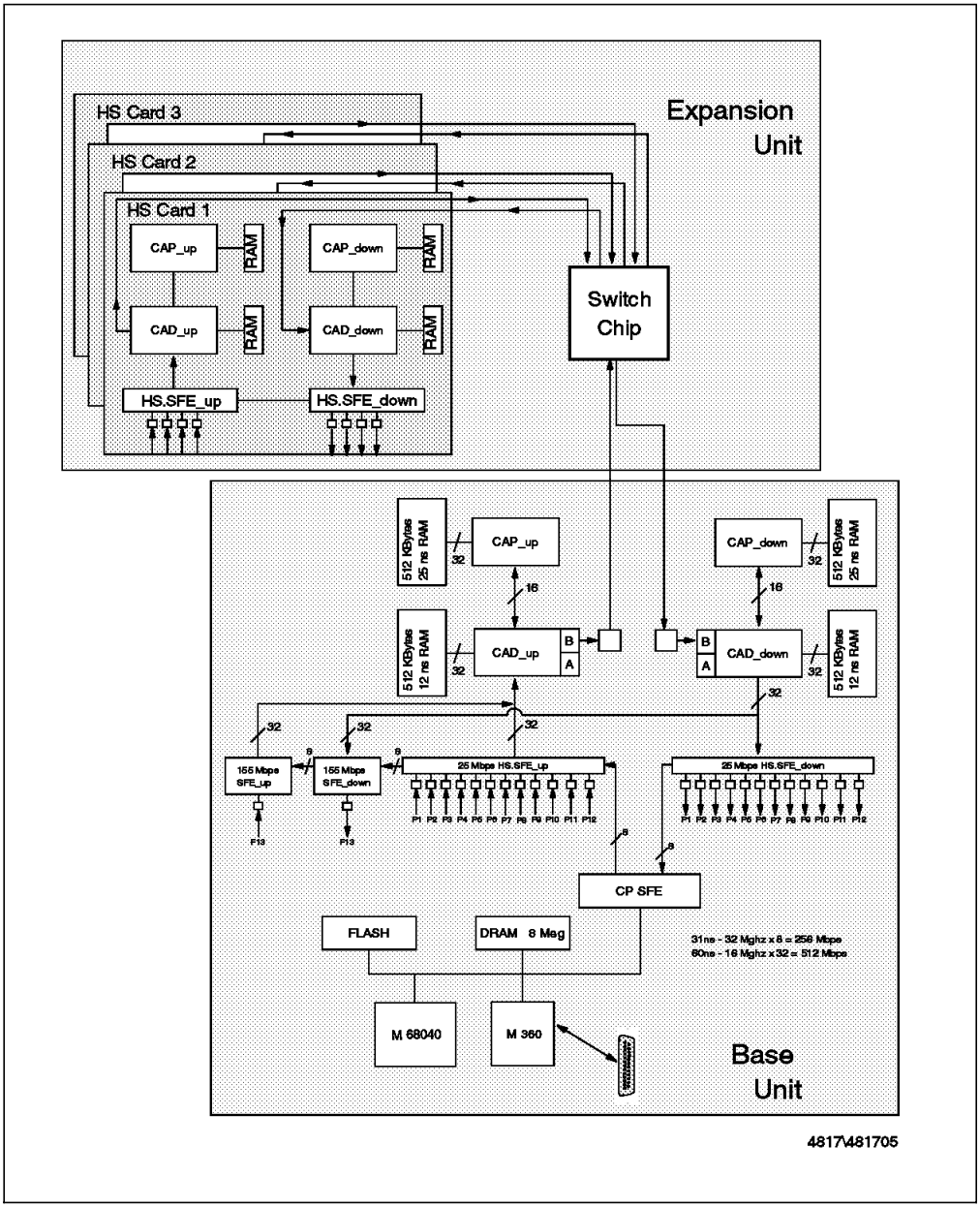

Figure 10. Hardware Architecture of the IBM 8285 Nways ATM Workgroup Switch Base and Expansion Unit

When the IBM 8285 expansion unit is installed, its switch chip, called a switch-on-a-chip, becomes the primary cell switch for the 8285 system. The CAD_up and CAD_down devices in the base unit and in any ATM modules link directly to this switch. Another way of saying this is that the link between the base unit's CAD_up and CAD_down is disabled, and all cells (even port-to-port) within the base unit or within an individual ATM module, are switched through the switch-on-a-chip.

Additional Information

The switch-on-a-chip is a scalable, non-blocking, shared buffer switching module that was developed at the IBM Research Laboratory in Zurich, Switzerland. This is the same switch that is used in other IBM ATM switches, such as the IBM 8260 Nways Multiprotocol Switching Hub and the IBM Nways 2220 Broadband Network Switch.

The architecture of the expansion unit is similar to that of the IBM 8260:

- Each module contains CAP/CAD components to interface to the ATM backplane.
- The ATM backplane is fully passive and uses female connectors to improve availability.
- The ATM backplane is point-to-point wired to connect each module directly to the switch-on-a-chip.

Note

This means that the IBM 8260 ATM CPSW Module is *not* supported in the IBM 8285 Expansion Chassis, which also means that any CPSW-exclusives, such as switch redundancy, are not supported.

However, the architecture is different in several key ways:

- The control point is in a separate module (the base unit) from the switch.
- The control point shares a set of CAP/CAD components with the ATM ports.

3.2 Switching Fabric

As described above, there are two switching mechanisms used in the IBM 8285, depending on whether the base unit is operating with or without an expansion unit. The following sections describe in detail the switching mechanism in each case.

3.2.1 Switching in the IBM 8285

This section describes the switching mechanism in the IBM 8285.

Before going into further details about the switching function of the 8285 switch, it is necessary to understand the internal frame format it uses. This format is described below.

3.2.1.1 Internal Cell Format

The 8285 switch uses the same internal frame format, a 64-byte extension of the standard 53-byte ATM cell, as the 8260 hub. This cell is constructed by the following process:

- The ATM cell received from a port by the SFE.
- The SFE calculates a header error check value and compares it to the HEC that arrived in the cell's header.
- If no error is detected (the calculated and transmitted HEC values match), the SFE strips the HEC from the cell's header and sends the resulting 52-byte ATM cell to the CAP/CAD.

- The CAP/CAD adds a 2-byte internal header (called a *routing header (RH)*), and 1-byte trailer.

  The RH contains the information necessary to route the internal cell. Basically, the switching information is contained in the Source Blade (SB) and Target Blade (TB) fields, which correspond to ports on the switch-on-a-chip, and which the switch uses in order forward the cell to the correct blade(s). The switch itself does not use destination port or VPC/VCC number when switching the cell. However, at the module level, the CAP/CAD would forward the cell to the appropriate port(s) based on the *target port (TP)* contained in the format field of the RH.

  Note: In this context, *blade* refers to the set of components that share a common CAP/CAD. This is normally a module, such as an ATM media module or the ATM Control Point and Switch module of the IBM 8260. However, by this definition, the IBM 8285 Base Unit can be considered a blade or module as well, since its ports share a common CAP/CAD.

Figure 11 on page 24 shows the internal cell format used in the IBM 8285. Note the internal cell format will be changed in future releases but the concept should remain similar and able to be referenced.

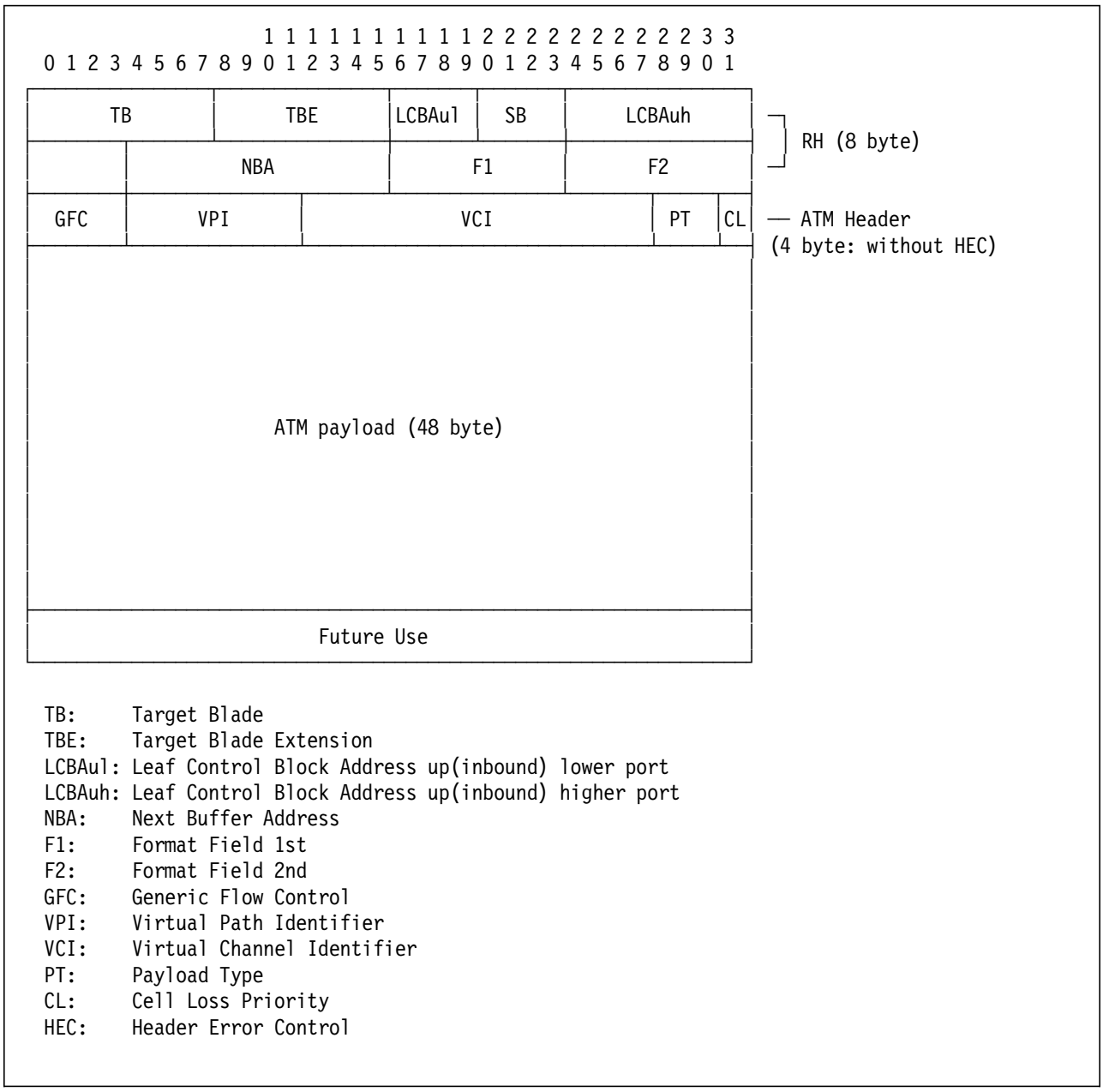

Figure 11. Internal Cell Format of the IBM 8285 Nways ATM Workgroup Switch

3.2.1.2 Switching without the Switch Chip

When no expansion chassis is connected, the IBM 8285 Base Unit implements a direct connection between CAD_up and CAD_down. This means that inbound cells would undergo the following process:

1. The SFE_up strips the HEC from valid cells and forwards the cell to the CAD_up.
2. The CAD_up prepares the internal cell and forwards it directly to the CAD_down.
3. The CAD_down uses the RH information to determine which ports to forward the cell to, strips the internal header, and forwards the 52-byte cell to the SFE_down.

4. The SFE_down performs the appropriate label-swapping, calculates a new HEC, and forwards the 53-byte cell across the physical interface.

Blade number 0 is assigned to the blade for the base unit.

Note

The *blade number* is used for the internal switching and is different from *physical slot number*.

3.2.1.3 Switching the Switch Chip

When the IBM 8285 Expansion Chassis, with its switch-on-a-chip, is connected, the connection between the base unit's CAD_up and CAD_down is disabled, and all traffic flows through the switch-on-a-chip. This means that Step 2 above becomes the following:

- 2A. The CAD_up prepares the internal cell and forwards it across the expansion interface cable to the switch-on-a-chip.
- 2B. The switch-on-a-chip decides which blade(s) to forward the cell to and forwards it to the CAD_down of the target blade(s) for further handling.

3.2.2 Switching Scenarios

The following describes the process of how cells are switched from one port to another port in the IBM 8285. To understand this process it is best to follow a cell as it enters one port and exits another and to see what actually happens as it goes through the various components. Please refer to 3.2.1.1, "Internal Cell Format" on page 22, as the following discussion assumes that you are already familiar with the internal cell format.

- **Point-to-Point Routing**

  The following describes what happens to a cell in a point-to-point connection:

  1. Receive the cell.

     a. CAD_Up prepares in advance, for every port, the address of the next cell assembly buffer. This is the location where the internal cell will be built in CAD_Store.

     b. An ATM cell is received by SFE_Up. Here the HEC of the ATM header gets checked. If it is a bad cell, it is discarded, otherwise the HEC is stripped and the remaining 52 bytes are delivered to CAD_Up.

     c. The connection from SFE_Up to CAD_Up is 32-bits wide so the cell is transferred in 13 4-byte blocks. There are port lines between SFE_Up and CAD_Up which indicate what port the cell came from. Using these port lines, the 4-byte block transfers can be mixed from different ports. For example, deliver a 4-byte block from Port 1, then deliver a 4-byte block from Port 2, then deliver a 4-byte block from Port 1 and so on. This ensures that no time is wasted in delivering data from a port that has no cells.

     d. When the first 4-byte block of a cell gets transferred, one of the control lines is raised to indicate the beginning of a cell.

     e. The SFE forwards each 4-byte block of the cell to CAD_Up, which stores it in CAD_Store using the address of the next cell assembly buffer prepared previously. However, CAD_Up skips the first 8 bytes, which are reserved for the routing header, before it stores the first

4-byte block. A 4-bit register pointing to the lower address of where the next 4-byte block should go is updated and is used as a displacement pointer from the cell buffer address.

f. CAD_Up writes *source port (SP)* in RH. When the cell is completely assembled in the CAD_Store, CAD_Up puts the cell buffer address in a general queue, to allow for cell assembly ending almost at same time (one cycle of SFE_Up/CAD_Up interface). Each cell will then be dequeued on a first-in/first-out basis from the general queue, and CAD_Up sends a copy of the first 4-byte block and the source port (SP) to CAP_Up. CAD_Up prepares the address of the next assembly cell buffer for this port. The address is determined from the port number, which indicates a register pointing to where these 4-bytes should be placed. This register is also updated.

2. Prepare the routing header (RH).

   a. The first 4-byte block of a cell is the first 4 bytes of the ATM cell header which contains the VPI/VCI. When CAP_Up receives the first 4-byte block with SP it now has all the information it needs to identify a particular connection: SP, VPI and VCI. From these three values, CAP_Up determines the inbound leaf control block address (LCBAup), which is the pointer to the leaf control block (LCB) for this connection.

   b. The LCB contains the target blade (TB). TB, LCBAup and source blade (SB), and RB/NRB connection parameter are given to CAD_Up to be written to the header of the internal cell in CAD_Store. CAP_Up knows the address of the beginning of this cell, so that the address is also given to CAD_Up to ensure that the information is written in the correct place in CAD_Store. In the case of an unknown SP/VP/VC, the cell is released by CAP_Up by sending to CAD_Up the cell buffer address, which can be used for another data movement.

      CAP_Up also performs smart discard on NRB AAL5 frame flows, which purges cells on an AAL5 frame basis in the case of NRB node congestion.

3. Place the cell in the queue.

   The cell is put by CAD_Up into the appropriate output queue (with the RB/NRB indication) so that prioritization of traffic can occur. There is an RB queue and an NRB queue.

   The cell is now ready to be switched.

4. Switch the cell.

   This step depends on whether or not the IBM 8285 has an expansion unit. In other words, whether the switching is done by the CAP/CAD or by the switch chip. When the IBM 8285 is installed without the expansion unit, the switching is done as follows:

   a. The connection between CAD_Up and CAD_Down has been enabled because the IBM 8285 does not have the switch chip.

   b. The cell is switched from CAD_Up to CAD_Down immediately.

   When the IBM 8285 is installed with the expansion unit, the switching is done as follows:

   a. When the expansion unit installed, all connections between the switch chip and the CAP/CADs are enabled. And then, the direct

connection between CAD_Up and CAD_Down in the base unit is disabled.

b. When the switch chip indicates to CAD_Up to give the next cell, CAD_Up gives the first cell from the appropriate queue based on its priority mechanism (RB over NRB Queue)

c. The cell is delivered to the switch chip, and the pointers of that queue are updated.

d. The switch chip switches the cell based on TB.

5. Receive the cell into the target blade.

   a. CAD_Down has prepared a location in advance for the next cell.

   b. CAD_Down receives the cell into CAD_Store in the general queue.

   c. CAD_Down dequeues the cell and sends CAP_Down a copy of the RH, which contains the LCBAup and the source blade.

6. Place the cell in the correct output queue and prepare it for transfer to SFE_Down.

   a. Using SB and LCBAup, CAP_Down determines LCBAdown. LCBAdown points to the LCB for the connection in the outbound blade. The LCB has VPI/VCI out, target port (TP), RB/NRB and Multicast indication. There is also part of the LCB in a shadow zone in CAD_Store for performance reasons.

   b. LCBAdown TP, NRB/RB, and Multicast indications from the LCB are given to CAD_Down.

   CAD_Down queues the cell in the corresponding target port queue (one RB and one NRB per port) with the indication received from CAP_Down and prepares it for transfer to SFE_Down.

7. Prepare and send a new ATM cell.

   a. When SFE_Down asks for the next cell of a port, CAD_Down moves the contents of LCBshadow, which has VPI/VCI out and the type of swapping (SWAP_TYPE) to be performed, plus the 52-byte cell to SFE_Down.

   b. SFE_Down modifies the header based on SWAP_TYPE. SWAP_TYPE indicates if only the VP needs to be swapped, if both the VP and VC need to be swapped or neither need to be swapped. The PTI field is always retrieved from the incoming header.

   c. SFE generates HEC.

   d. SFE presents the cell to the specific interface.

- **Point-to-Multipoint Routing**

  In a point-to-multipoint (multicast) connection, the process is very similar. Steps remain the same right up until the cell is ready to be switched. The TB field actually indicates that this cell is part of a multicast connection by having the first bit of TB set to 1. The other 7 bits form the multicast ID (MID). In a point-to-point connection, the first bit is set to 0 and the other 7 bits indicate the target blade.

  1. Switch the cell.

     This step depends on the IBM 8285 has a expansion unit or not. In other words, the switching is done by the CAP/CAD or the switch chip. When

the IBM 8285 is installed without the expansion unit, the switching is done as follows:

a. The cell is switched from CAD_Up to CAD_Down immediately as well as the case of point-to-point connection. The CAP_Up does not recognize the multicast ID.

When the IBM 8285 installed with the expansion unit, the switching is done as follows:

a. The switch chip recognizes that the TB is actually a Multicast ID; thus, using the MID as a pointer, it looks at its switch multicast tree table to get 16 bits. Each bit corresponds to a blade. If the bit is on, then that blade is part of the multicast tree.

b. The switch chip switches the cell to the target blades based on the multicast tree table.

2. Receive the cell into the target blade.

   This step is the same as in a point-to-point connection described earlier.

3. Place the cell in the correct output queue and prepare for transfer to SFE_Down.

   a. Using SB and LCBA, CAP_Down determines LCBAdown. Since this is a multicast connection, LCBAdown actually points to a chain of LCBs. Each LCB in the chain represents the branches on the multicast tree on this blade. Each LCB in the chain has VPI/VCI out, SWAP_TYPE and target port (TP) and last multicast (Last_MC) indication. There is also a shadow of the LCB chain in CAD_Store for performance reasons.

   b. The same steps as in the unicast case apply. But when the cell has been sent to SFE_Down, the CAD_Down will re-enqueue this cell in the general queue so that CAP will reprocess this cell with the next LCB in the chain. This is done till CAP_Down finds the LAST_MC indication in the LCB.

4. Prepare and send a new ATM cell.

These scenarios assume that the appropriate tables have been assembled already by the 8285 ATM Control Point and stored in the appropriate CAP/CAD. This would be done, for instance, during the call establishment process. To communicate such information to internal devices (such as CAD, CAP, an SFE), the 8285 ATM Control Point uses a special port number, F (which is unique within the switch), and special internal cells, called guided cells, which can be discriminated from the other internal cells, called swapped cells, by its format field.

3.3 Control Point Codes

There are three types of control point microcode:

- **Boot Code**

  This resides in flash memory on the control point and is the first thing that executes after a power-on or reset. It contains initialization, diagnostics and support for download out-of-band commands. This code executes straight from flash memory and is normally used to load the operational code.

- **Operational Code**

This code is also on the control point and is executed once the boot code has finished. There are two copies of the code stored in the flash memory. One of these copies is identified as current and is loaded into RAM during the initialization process. This code is executed from RAM. The second copy of the operational code allows new operational code to be loaded into the control point while the control point is running, and then swapped (which resets the ATM subsystem) when it is less disruptive to network operations.

- **FPGA Code**

  This code configures the various internal chips on the IBM 8285 base unit so that they perform their desired ATM functions. There are two copies of the FPGA code stored in flash memory. One of these copies is identified as current code. The current code is loaded into the internal chips of the appropriate components during the initialization process. The second copy of the FPGA code allows new FPGA code to be loaded while the IBM 8285 is operational, and then swapped (which resets the ATM subsystem) when it is less disruptive to network operations.

The following sections describe the code levels that are currently shipped, are announced, or are available in the future.

3.3.1 Control Point Levels

Table 1 lists the levels of control point code that are currently available for the 8285 switch.

Table 1. Control Point Levels Summary of the IBM 8285 Nways ATM Workgroup Switch

Control Point Level	Available	Highlights
V1.0.0	March 1996	Initial release
V1.0.1	April 1996	Fixed some problems in initial release
V1.2.0	July 1996	TR LEC, EU, and 8260 modules support 1
V1.3.0	October 1996	New 8260 module support 2
V1.4.0	October 1996	Connection capacity increased, Variable VPC/VCI, ABR flow control and PVC multipoint support 3

Notes:

1 Except A-CPSW, MSS Server and 8271/8272 modules

2 A3-MB155 module

3 ATM firmware upgrade kit required

These control point microcode levels (except the obsolete ones) are available on the Internet and can be downloaded via the Web or by FTP. And the code can be downloaded into the IBM 8285 either out-of-band via a SLIP-connected workstation, or inband via an FTP file transfer. For more information about how to get and download the code, refer to 6.4, “Microcode/Picocode Considerations” on page 110.

3.3.2 Control Point V1.2

The Control Point V1.2 has been available since July 1996. It contains the operational code V1.2.0, the boot code V1.2.0 and FPGA 3. The FPGA is optional but highly recommended.

The highlights of new and enhancement functions are as follows:

- Token-Ring (IEEE 802.5) LAN Emulation Client (LEC) Support

  The previous levels allowed the inband monitoring of the IBM 8285 in a Classical IP environment as well as in Forum-Compliant LAN Emulation (Ethernet / IEEE 802.3). This support has been extended to Token-Ring (IEEE 802.5) Forum-Compliant LAN Emulation.

- Expansion Unit and 8260 ATM Modules Support:

  This level supports the IBM 8285 Expansion Unit and IBM 8260 ATM modules as follows:

  – ATM 4-Port 100 Mbps MIC Fiber Module
  – ATM 4-Port 100 Mbps SC Fiber Module
  – ATM 2-Port 155 Mbps Flexible Media Module
  – ATM 12-Port 25 Mbps UTP Concentrator Module
  – ATM 4-Port Ethernet/TR Bridge Module
  – ATM WAN Module

  Note

  When this level became available, it supported all IBM 8260 ATM media and bridge modules then announced. However, there are the following modules are currently announced and not supported by the IBM 8285 expansion unit:

  - MSS Module
  - 8271/8272 LAN Switch Modules

- MIB Enhancement (MIB 1.5)

  The IBM private MIB for the IBM 8285 is enhanced corresponding to the other enhancements.

3.3.3 Control Point V1.3

The Control Point V1.3 has been available since October 1996. It contains the operational code V1.3.0 and the boot code V1.3.0. No FPGA is included in this level.

The highlights of new and enhancement functions are as follows:

- New 8260 ATM Modules Support

  In addition to the control point level V1.2, this level supports the new IBM 8260 ATM modules as follows:

  – ATM 3-Port 155 Mbps LAN Concentration Module

- MIB Enhancement (MIB 1.6)

  The IBM private MIB for the IBM 8285 is enhanced corresponding to the other enhancements.

3.3.4 Control Point V1.4

The Control Point V1.4 has been available since October 1996 as well as the V1.3. It contains the operational code V1.4.0, the boot code V1.4.0 and FPGA code 0B40 and 0C10. The FPGA code 0C10 is for the ATM 3-port 155 Mbps LAN Concentration module, ATM 12-port 25 Mbps UTP Concentrator module and for the 8285 Base Unit. The FPGA code 0B40 is for the others.

This level is also called as the ATM Firmware Upgrade Kit (MES 5099) and the FPGA upgrade is mandatory. The boot and operational code V1.4.0 supports several functions with new FPGA codes in addition to the functions provided by V1.3.0 of those codes. The FPGA codes for all available ATM modules are contained in the ATM Firmware Upgrade Kit.

The highlights of new and enhancement functions are as follows:

- Increase of Number of Connections

  For all ATM media modules currently announced, the number of bidirectional connections is increased from 992 to 4,064 per ATM blade. However, the maximum number of connections per an IBM 8285 is 2,048 due to the limitation of its control point.

- Variable Range of VPI/VCI Values Support

  The ITU-T define the ATM cell format and the virtual path identifier (VPI) and virtual channel identifier (VCI) have 8 bits (VPI value comprised between 0 and 256) and 16 bits (VCI value comprised between 0 and 65536). However, in actual campus network, the full address range should not be used and the UNI specification allows you to restrict the number of active VPI and VCI bits. The IBM 8285 supports a 14 or 12-bit address range for VPI/VCI depending on which port is used. And prior to the control point V1.3, the range was fixed to a 2-bit VPI (0 through 3) and 10-bit VCI (0 through 1023) for the 25 Mbps ports (base unit and 25Mbps module) and 4-bit VPI (0 through 15) and 10-bit (0 through 1023) for the other ports. The control point V1.4 supports variable range of VPC/VCC. This function allows you to have more virtual path connections (VPCs) or virtual channel connections (VCCs) than previous levels along with the customer requirement. The range supported on an ATM port depends on which port is used.

  – For the 25 Mbps ports:

    One of the following three patterns of range can be selected:

    - VPI/VCI: 0 bit/12 bits (VPI=0, VCI=0 through 4095)
    - VPI/VCI: 2 bits/10 bits (VPI=0 through 3, VCI=0 through 1023)
    - VPI/VCI: 4 bits/8 bits (VPI=0 through 15, VCI=0 through 256)

  – For the other ports:

    One of the following three patterns of range can be selected:

    - VPI/VCI: 0 bit/14 bits (VPI=0, VCI=0 through 16383)
    - VPI/VCI: 4 bits/10 bits (VPI=0 through 15, VCI=0 through 1023)
    - VPI/VCI: 6 bits/8 bits (VPI=0 through 63, VCI=0 through 256)

  In addition, the network administrator can define upper limits for VPI/VCI values to meet specific ranges supported by some ATM UNI devices. The ATM Forum-Compliant UNI stations inform the ATM switch about the supported values of VPI/VCI. In case a station fails to do so, this may

prevent interworking with the IBM ATM switches. This function solves this problem by allowing the the network administrator to set the VPC/VCC range on a given ATM port on the ATM switch, thereby enabling the interworking with non-compliant devices. For example, you can restrict the VPI value equal to 0 and VCI value comprised between 0 and 63 by specifying 0/6 as the VPI/VCI.

Note

If you change the VPI/VCI range for the SSI or NNI port, you *must* specify the same value on both ends.

- ABR Flow Control Support

  On the ATM 12-port 25 Mbps UTP Concentrator module, the ATM 3-port 155 Mbps LAN Concentration module, and on the 12-port 25 Mbps base unit, the end user can add the ATM Forum-compliant *available bit rate (ABR)* flow control through Explicit Forward Congestion Notification Indication (EFCI) marking. When congestion occurs due to excessive traffic flow, the IBM 8285 and 8260 modules can now mark the EFCI bit in the ATM cells to indicate a congestion condition asking the destination station to notify the source device to reduce its traffic.

- Increase Buffer Size

  When multiple ATM sources try to send traffic over one link (for instance the one to which a server is attached), using UBR or ABR class of service, congestion conditions might occur because the aggregate traffic exceeds the capacity of the LAN traffic over ATM. By having a larger buffer size (8,000 cells) the A12-MB25 and A3-MB155 modules are able to absorb bursts of traffic of longer duration, thereby delaying the trigger of the congestion control mechanism, such as Early Packet Discard. This improves the overall response time and relieves end systems from extra frame retransmissions.

- PVC Multipoint Support

  In addition to the existing support of point-to-multipoint SVCs, this introduces the smart PVC point-to-multipoint function. Point-to-multipoint trees can be defined now with either fixed permanent virtual paths (PVPs) or fixed permanent virtual channels (PVCs). You only need to define the parameters (VP or VP/VC values) for the root of the tree and the leaves, without any definition for intermediate switches. In case of failure on these intermediate switches, the connections are automatically re-established.

- New 8260 ATM Modules Support

  In addition to the control point level V1.2, this level supports the new IBM 8260 ATM modules as follows:

  – ATM 3-Port 155 Mbps LAN Concentration Module

- MIB Enhancement (MIB 1.6)

  The IBM private MIB for the IBM 8285 is enhanced corresponding to the other announcements.

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3.4 ATM Backplane / Expansion Unit Connection

As described in Figure 9 on page 18, there are several ATM buses to connect each component of IBM 8285. The buses between CAP/CADs or CAP/CAD and the switch chip are called as the ATM backplane. In the IBM 8285, the ATM backplane is extended to the connection between the base and expansion unit. When the IBM 8285 is installed with the expansion unit, they are connected by a special cable, called the *expansion interface cable*, which has 68 pins. On the other hand, as described in some documents, such as the *IBM 8260 As a Campus ATM Switch*, all ATM modules have 120 pins for backplane connection. The difference comes from the number of modules supported by the IBM 8285 and the IBM 8260 whether or not it supports the redundant switch configuration. Except for the redundant switch function, both of the IBM 8285 and IBM 8260 ATM backplanes are fully equivalent functionally to an ATM blade.

You can find the pin layout of the IBM 8285 expansion interface in the appendix of the *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*. For more information about the IBM 8260 ATM backplane, refer to *IBM 8260 As a Campus ATM Switch*, SG24-5003.

Table 2 shows the characteristics of typical buses implemented in the IBM 8285.

Table 2. ATM Buses Implemented in the IBM 8285 Nways ATM Workgroup Switch

Bus Location	Bus Speed
CAD_Up and CAD_Down (ATM backplane in the base unit)	256 Mbps (32 MHz x 8 bit parallel)
CP SFE and 25 Mbps HS.SFE_Up/Down	256 Mbps / FDX [1]
25 Mbps HS.SFE_Up/Down or 155 Mbps SFE_Up/Down and CAD_Up/Down	512 Mbps (16 MHz x 32 bit parallel) / FDX [1]
CAD_Up/Down and the switch chip (ATM backplane across the expansion unit)	256 Mbps / FDX [1]

Note

[1] FDX means each up (inbound) and down (outbound) works simultaneously and the maximum capacity should be double (256 Mbps/FDX : 512 Mbps).

As described above, the internal bandwidth for each blade should be 256 Mbps. However, we have to consider that the IBM 8285 uses a 64-byte internal cell instead of a 53-byte ATM standardized cell. As a result, the available ATM bandwidth for the ATM cell transfer should be decreased from the internal bandwidth, 256 Mbps per blade, to 212 Mbps (256 Mbps x 53/64) per blade by the overhead of the internal cell header/trailer.

3.5 LAN Emulation Server Functions

The IBM 8285 integrates a Forum-compliant LAN Emulation Server (LES) and Broadcast and Unknown Server (BUS) functions in the control point. The LES/BUS functions are performed with or without external a LAN Emulation Configuration Server (LECS).

The IBM 8285 can support up to two sets of the LES/BUS functions with any combinations of the types of LAN emulation, token-ring (IEEE 802.5) and Ethernet

(IEEE 802.3). The maximum number of the LAN Emulation Clients (LECs) is 128 regardless the number of the LES/BUS, so it should be the sum of the LECs supported by the IBM 8285 when two LES/BUS are used.

The LES/BUS gives an impact on CP performance when running so that the processor and memory are mainly shared between signaling, BUS and routing. However, it is designed to prevent the CP traffic from the delay and buffer accumulation by assigning lower priority to the broadcast traffic.

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Chapter 4. IBM 8285 ATM Modules

This chapter describes the various functions and features that are available on 8285 ATM modules.

4.1 Modules Currently Available for the 8285 ATM Subsystem

The current ATM modules for the IBM 8285 are:

- ATM 12-Port 25 Mbps UTP Concentrator Module
- ATM 2-Port 155 Mbps Flexible Media Module
  - 1-port ATM 155Mbps Multi-mode Fiber I/O card
  - 1-port ATM 155 Mbps Single-mode Fiber I/O card
  - 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45)
  - 1-port ATM 155 Mbps STP I/O card (DB9)
- ATM 3-Port 155 Mbps LAN Concentration Module
  - 1-port ATM 155Mbps Multi-mode Fiber I/O card
  - 1-port ATM 155 Mbps Single-mode Fiber I/O card
  - 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45)
  - 1-port ATM 155 Mbps STP I/O card (DB9)
- ATM 4-Port 100 Mbps MIC Fiber Module
- ATM 4-Port 100 Mbps SC Fiber Module
- Video Distribution Module
- ATM 4-Port TR/Ethernet Bridge Module
- ATM WAN Module
  - 1-port E3 I/O card
  - 1-port DS3 I/O card
  - 1-port OC3 I/O card (SMF)
  - 1-port OC3 I/O card (MMF)
  - 1-port STM1 I/O card (SMF)
  - 1-port STM1 I/O card (MMF)

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4.2 Some Common Elements among the 8285 Modules

The following sections describe some of the common elements shared by the 8285 modules.

4.2.1 Maximum Capacity

All 8285 modules have a backplane capacity of 212 Mbps. In order to provide guaranteed service, the maximum configurable reserved bandwidth is 185 Mbps (85% of 212 Mbps). The non-reserved traffic will use whatever bandwidth is available, including bandwidth that is reserved but not being used.

4.2.2 Variable VPC/VCC Value Ranges

With the latest release of 8285 code (Release 1.4), the 8285 modules now support variable VPC/VCC range values. That is to say, they allow you to manage your network more precisely by allocating varying numbers of bits to the VPC and VCC portions of the header on a port-by-port basis.

Note

The VPC/VCC range *must* be the same on both ends of an SSI or NNI link.

With one exception, noted below, all of the modules allocate 14 bits to the VPC/VCC portion of the header, which you can allocate in one of the following ways:

- Mode 0/14 (all 14 bits assigned to VCC):
  - VPC=0
  - VCC range is 0-16383
- Mode 4/10 (4 bits for VPC, 10 bits for VCC):
  - VPC range is 0-15
  - VCC range is 0-1023
- Mode 6/8 (6 bits for VPC, 8 bits for VCC):
  - VPC range is 0-63
  - VCC range is 0-255

The exception to the above is the newest module, the ATM 12-Port 25 Mbps UTP Concentrator Module, which allocates only 12 bits to the VPC/VCC portion of the header, and which allows the following modes:

- Mode 0/12 (all 12 bits assigned to VCC):
  - VPC=0
  - VCC range is 0-4095
- Mode 2/10 (2 bits for VPC, 10 bits for VCC):
  - VPC range is 0-3
  - VCC range is 0-1023
- Mode 4/8 (4 bits for VPC, 8 bits for VCC):
  - VPC range is 0-15
  - VCC range is 0-255

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For all modules, you can define upper limits for VP/VC values at the port level to facilitate interoperability with certain ATM devices that have constraints on what values they will accept. This is done using the Set PORT command, which has a new parameter, VPI_VCI: #bits_vpi.#bits_vci.

4.3 ATM 12-Port 25 Mbps UTP Concentrator Module

The ATM 25 Mbps UTP Concentrator Module is a single-slot concentrator module that provides low-cost access to a high-performance ATM network. It is ideal for upgrading your legacy LAN users and for providing higher performance to new users.

It has the following characteristics:

- 12 Forum-Compliant ATM 25.6 RJ-45 ports capable of supporting shielded and unshielded twisted pair cabling.
- Supports user-to-switch, server-to-switch, and switch-to-switch connections in any combination.
- Supports ATM Forum Available Bit Rate (ABR) Service using Explicit Forward Congestion Control (EFCI) marking.
- Has a large 8,000 cell buffer to smooth bursts of traffic without triggering congestion control mechanisms.
- Supports UNI 3.0, UNI 3.1, and UNI translation.
- Expands IBM 8285 Nways ATM Workgroup Switch capacity up to 48 ports with optional 8285 Expansion Chassis (FC# 5502).

4.3.1 Sample Scenarios

The ATM 12-Port 25 Mbps UTP Concentrator Module is a high-performance card that is very cost-effective for connecting high-bandwidth users and servers into a workgroup or an ATM network. In addition, it can be used to provide redundant links to a backbone or server to provide higher bandwidth and improved reliability. Figure 12 on page 39, Figure 14 on page 41, and Figure 13 on page 40 show some ways the ATM 12-Port 25 Mbps UTP Concentrator Module can be used with the 8285 switch.

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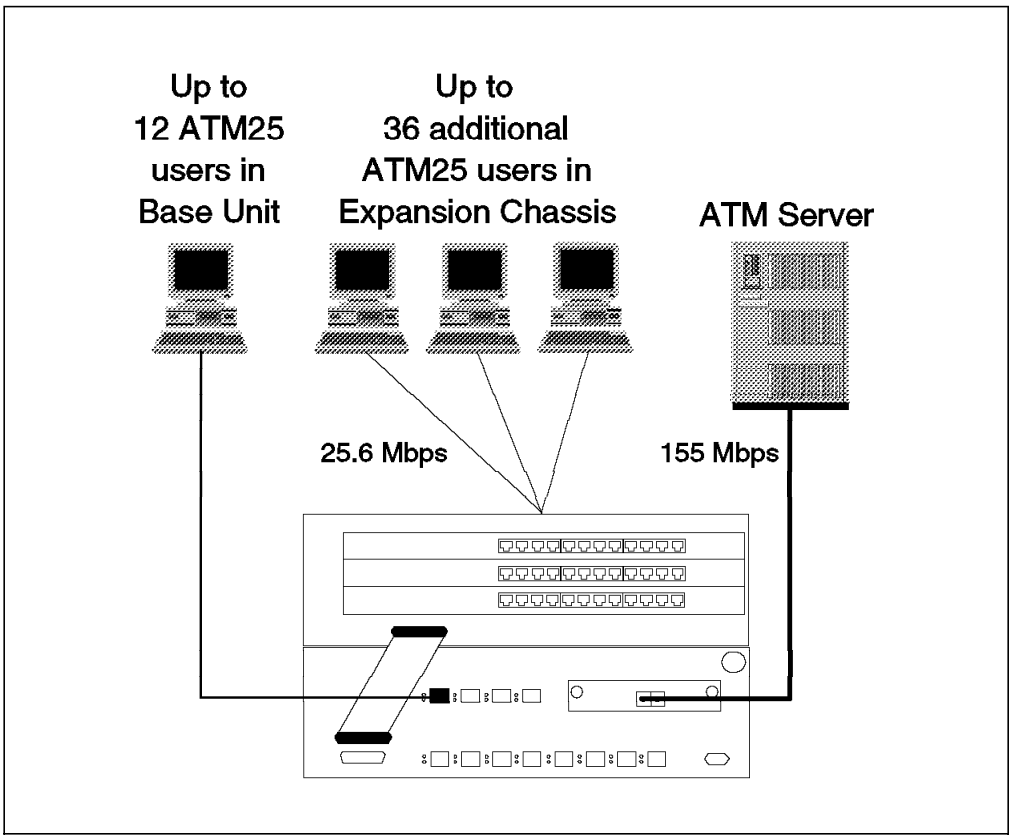

Figure 12. ATM 12-Port 25 Mbps UTP Concentrator Module Workgroup

The first example, a workgroup configuration, shows how you might set up a very cost-effective stand-alone workgroup by merely changing adapters in the workstations and connecting them to the 8285 switch. This simple change provides up to 25 Mbps of bandwidth to the desktop for up to 48 users per 8285, and gives them access to a high-speed server.

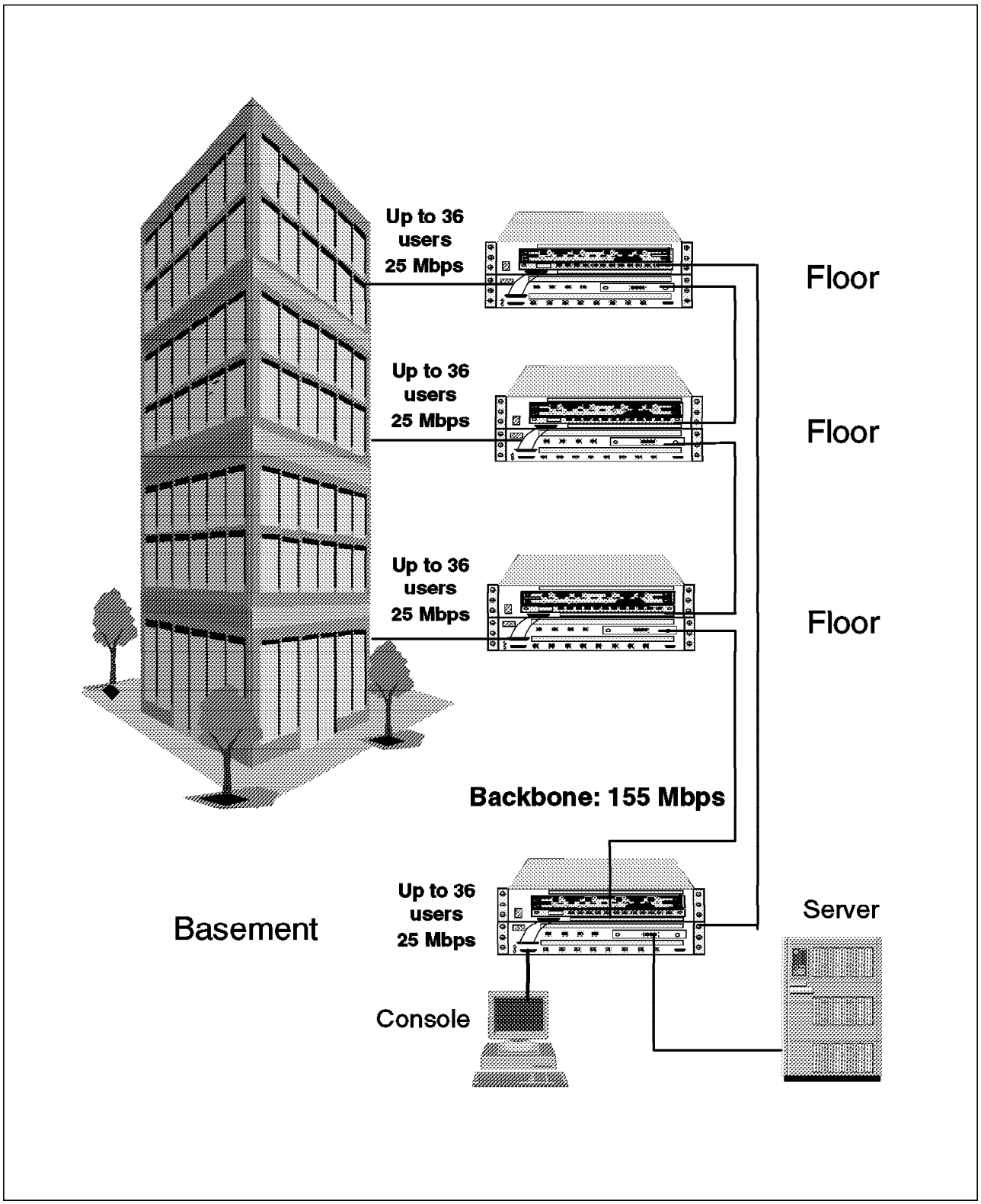

Figure 13. 8285 Low-Cost Configuration Implementation

The second example shows a building with 8285s on floors and in the basement. The backbone and server are working at 155 Mbps. By ordering an 8285 model 00P, it is possible to create an ATM network at a very attractive price, since it provides both the base unit and 12 ATM25 workstation adapters at a special bundled price.

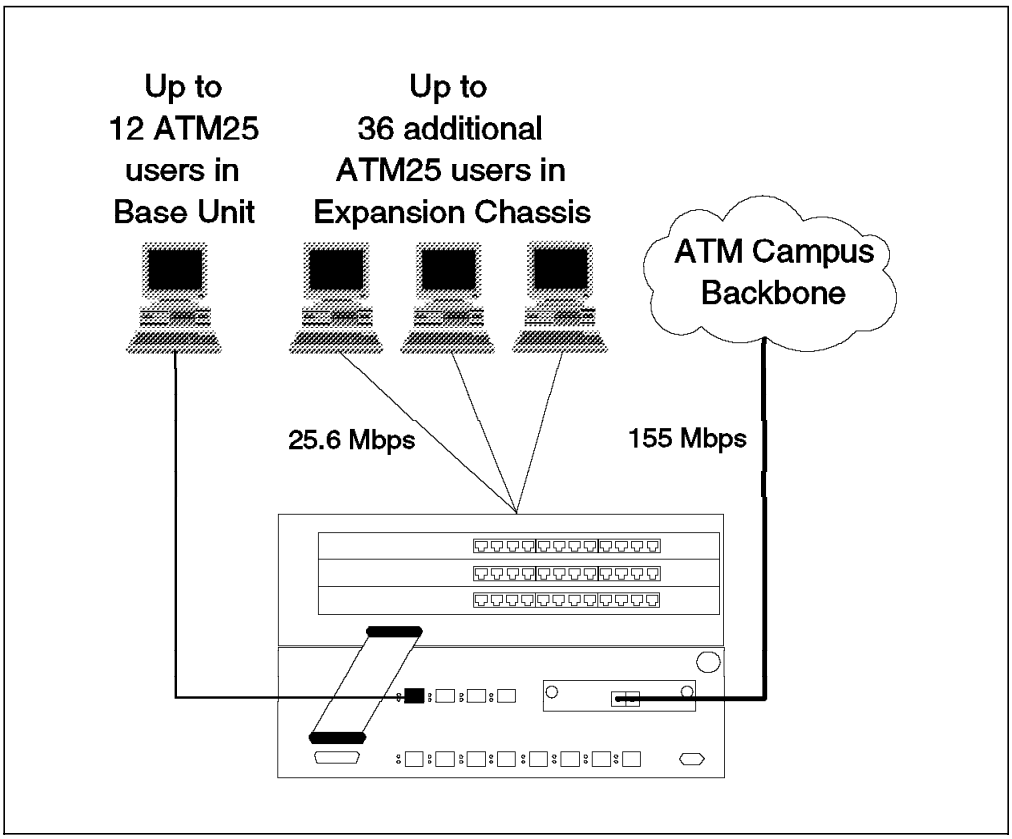

Figure 14. 8285 with ATM 12-Port 25 Mbps UTP Concentrator Modules as an Access Switch

The third example shows how you can connect the ATM25 workgroup into the backbone network to access additional high-speed resources using only the standard ATM 155 Mbps uplink. In this capacity, the 8285 makes an excellent ATM floor switch, especially when used in conjunction with the IBM 8260 Nways Multiprotocol Switching Hub as the backbone or collapse-point switch.

By implementing a second backbone link (using either the ATM 2-Port 155 Mbps Flexible Media Module or the ATM 3-Port 155 Mbps LAN Concentration Module) connected to a different switch in the backbone, you can take advantage of the additional bandwidth during normal operations, and provide availability to your workgroup even if one of the collapse-point switches fails.

4.4 ATM 2-Port 155 Mbps Flexible Media Module and ATM 3-Port 155 Mbps LAN Concentration Module

The ATM 2-Port 155 Mbps Flexible Media Module and the ATM 3-Port 155 Mbps LAN Concentration Module are single-slot concentrator modules that are ideal for high-speed connections to both local resources and to devices up to 20 Km away. They have the following characteristics in common:

- Provide two or three ports, each capable of supporting a 155 Mbps (full-duplex) connection to either a user, a server, or another switch. The traffic received from these ports will be multiplexed into the backplane connection between the ATM 155 Mbps Media Module and the switch-on-a-chip.

  Each port can support any of the following I/O cards:

Table 3. ATM 155 Mbps Media Module Supported I/O Cards

Feature	Part Number	Interface	Cable
8800	58G9667	SC	Multi-Mode Fiber
8801	58G9855	SC	Single-Mode Fiber
8802	58G9856	RJ-45	UTP5/STP
8803	58G9857	DB9	STP

- Support either SONET STS-3C or SDH STM-1 on any port at speeds of 155.520 Mbps.

  STS-3c Limitations

  The STS-3c implementation is a Lite implementation, which, although fully compliant with ATM Forum standards, is lacking some of the management and overhead portions of a full SONET implementation. It will interoperate with the 1-port OC3 I/O card (SMF) and the 1-port OC3 I/O card (MMF) that are installed in an ATM WAN Module. However, neither the 1-port ATM 155 Mbps Single-mode Fiber I/O card nor the 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45) are suitable for direct connection to a public bearer service other than dark fiber. In addition, there may be incompatibilities with certain adapters that expect a full SONET implementation.

  STM-1 Limitations

  The STM-1 implementation is a Lite implementation, lacking some of the management and overhead portions of a full SDH implementation. It will interoperate with the 1-port STM1 I/O card (SMF) and the 1-port STM1 I/O card (MMF) that are installed in an ATM WAN Module. However, neither the 1-port ATM 155 Mbps Single-mode Fiber I/O card nor the 1-port ATM 155 Mbps UTP/STP I/O card (RJ-45) are suitable for direct connection to a public bearer service. In addition, there may be incompatibilities with certain adapters that expect a full SDH implementation.

  Please refer to *Asynchronous Transfer Mode (ATM): Technical Overview* for more information on the SONET and SDH standards.

- Hot-pluggable in any slot in the 8285 Expansion Chassis.
- Support UNI, SSI, and NNI on either port in any combination.

- Support UNI 3.0 and/or UNI 3.1 on all ports and will attempt to adapt to the standards of the connected device. That is to say, if a remote UNI 3.1 device needs to connect to a UNI 3.0 device connected to the ATM 155 Mbps module, the module will attempt to translate between the two at the output port.

4.4.1 Differences between the 2- and 3-Port ATM Modules

Although these two modules are very similar, there are some key differences. Specifically, the ATM 3-Port 155 Mbps LAN Concentration Module has the following additional features:

- Supports ATM Forum Available Bit Rate (ABR) Service using Explicit Forward Congestion Control (EFCI) marking.
- Has a large 8,000 cell buffer to smooth bursts of traffic without triggering congestion control mechanisms.

4.4.2 ATM 155 Mbps Media Module Traffic Management

The ATM 155 Mbps Media Module provides reserved bandwidth (RB) and non-reserved bandwidth (NRB) with the following caveats:

- For RB traffic, the maximum bandwidth that can be reserved is 85% of the total throughput capacity, which is:
  - Port Interface: 131 Mbps (85% of 155 Mbps)
  - Backplane Interface: 180 Mbps (85% of 212 Mbps)

4.4.2.1 Reserved Bandwidth Constraints

In order to fairly allocate reserved bandwidth among its ports, the ATM 155 Mbps modules will enforce traffic limitations on each port that is configured for SSI, as follows:

- For a single SSI link between two 8285s, the maximum bandwidth that can be reserved is 131 Mbps (85% of 155 Mbps).
- If a second SSI port is configured, the amount of reserved bandwidth for the first port will be recalculated and each SSI link will be allocated 90 Mbps (50% of 180 Mbps). If the peak cell rate (PCR) in the first SSI port exceeds 90 Mbps when you try to configure the second port, the command setting for the second SSI port will be rejected since the first port could not be throttled back.
- If a third SSI port is configured (on the ATM 3-Port 155 Mbps LAN Concentration Module only), the amount of reserved bandwidth for the first two ports will be recalculated and each SSI link will be allocated 60 Mbps (33% of 180 Mbps). If the peak cell rate (PCR) in either of the first two SSI ports exceeds 60 Mbps when you try to configure the third port, the command setting for the third SSI port will be rejected since the other ports could not be throttled back.

4.4.3 Sample Scenarios

The ATM 155 Mbps Media Modules are high-performance cards that are ideal for connecting high-bandwidth users and servers into either a workgroup or an ATM network. In addition, they can be used to provide redundant links to a backbone or server to provide higher bandwidth and improved reliability. Figure 15 on page 44 shows how the ATM 2-Port 155 Mbps Flexible Media Module can be used as a concentrator for a high-performance workgroup.

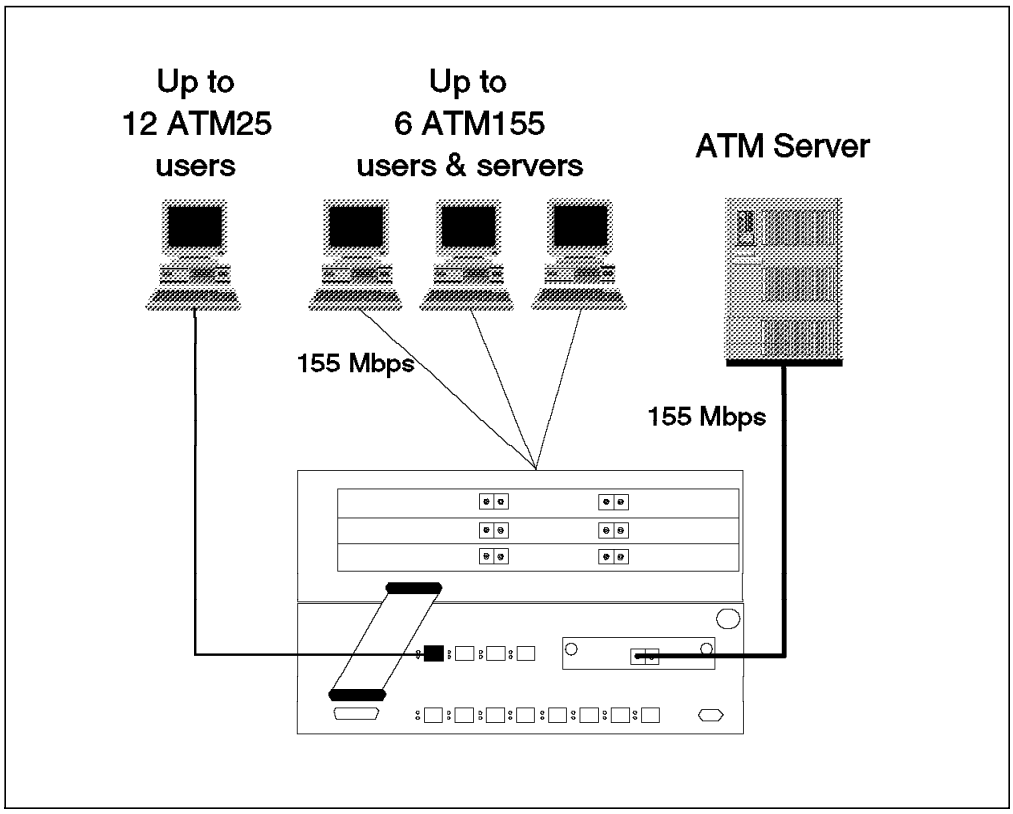

Figure 15. ATM 2-Port 155 Mbps Flexible Media Module High-Performance Workgroup

In this scenario, six users are connected to the 8285 via a high-performance ATM 155 Mbps adapter, such as the IBM Turboways ATM 155 Mbps Adapter, connected in to ATM 2-Port 155 Mbps Flexible Media Modules installed in the 8285 Expansion Chassis. This allows all six users to access the ATM 155 Mbps server, connected to the ATM 155 Mbps port on the base unit, for such bandwidth-intensive applications as CAD/CAM, video playback, etc. In addition, 12 ATM25 users can access the same high-performance ATM server for such applications as video conferencing and traditional LAN server applications.

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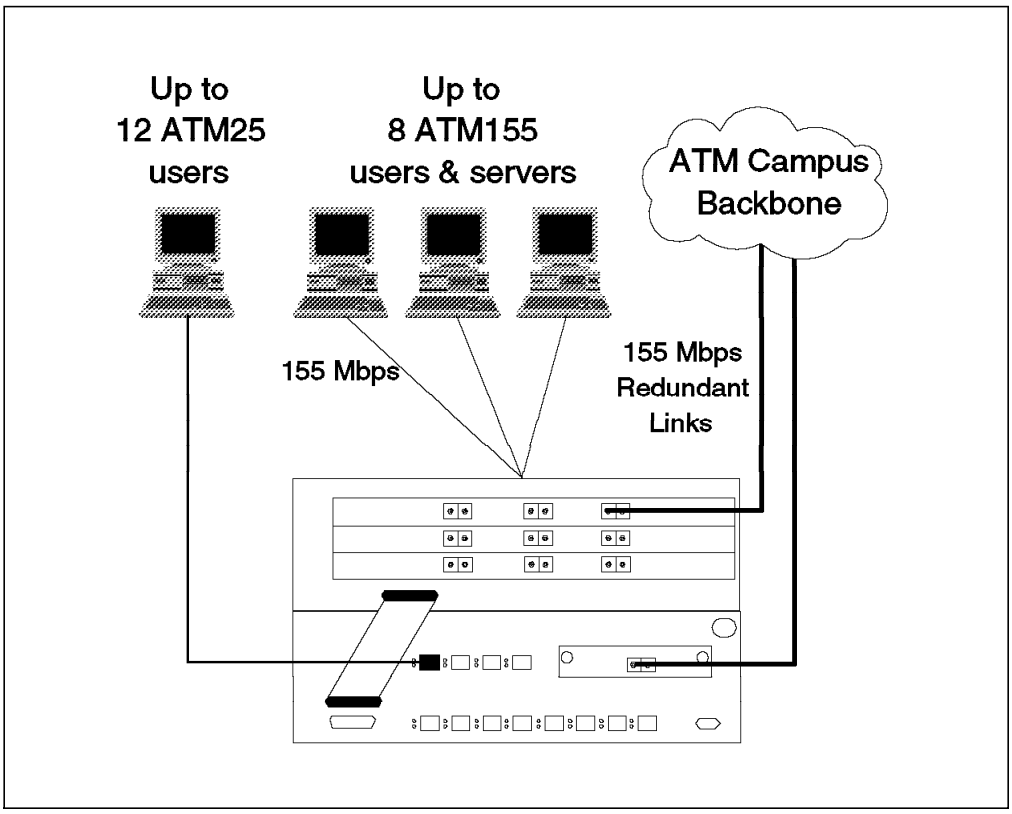

Figure 16. ATM 3-Port 155 Mbps LAN Concentration Module with Redundant Backbone Links

Figure 16 shows how you can use the ATM 3-Port 155 Mbps LAN Concentration Module to connect a high-performance workgroup into the backbone network to access additional high-speed resources. In this case, up to eight users, using workstations with high-performance ATM 155 Mbps adapters, such as the IBM Turboways ATM 155 Mbps Adapter, are connected in to ATM 3-Port 155 Mbps LAN Concentration Modules installed in the 8285 Expansion Chassis. This enables each user to access resources across the ATM backbone network. By providing redundant backbone links, preferably to separate backbone switches, the ATM 3-Port 155 Mbps LAN Concentration Module also provides aggregate backbone access bandwidth as high as 310 Mbps and ensures availability to the workgroup should one of the links fail. Up to 12 ATM25 users can also take advantage of this increased bandwidth and availability.

Whether as a workgroup solution or as a backbone solution, the ATM 2-Port 155 Mbps Flexible Media Module and the ATM 3-Port 155 Mbps LAN Concentration Module meet the needs of bandwidth-intensive applications, with the ATM 3-Port 155 Mbps LAN Concentration Module offering more ports, a lower price/port, and additional buffering to handle bursty traffic.

4.5 ATM 4-Port 100 Mbps MIC Fiber Module and the ATM 4-Port 100 Mbps SC Fiber Module

The ATM 4-Port 100 Mbps MIC Fiber Module and the ATM 4-Port 100 Mbps SC Fiber Module are single-slot concentrator modules that are identical except for they have MIC and SC connectors, respectively. They have the following characteristics:

- Hot-pluggable in any slot in the 8285 Expansion Chassis.
- Each module provides four taxi ports, each capable of supporting 100 Mbps (full-duplex). The traffic received from these ports will be multiplexed into the backplane connection between the A4-FB100 module and the switch-on-a-chip.
- Support for workstation connections (UNI) up to 2 km from the 8285.
- Support for a connection between two A4-FB100 ports (SSI/NNI) up to 3 km.

4.5.1 Sample Scenarios

The 4-port 100 Mbps modules are high-performance cards that are very cost-effective for connecting high-bandwidth users and servers into a workgroup or an ATM network. In addition, they can be used to provide redundant links to a backbone or server to provide higher bandwidth and improved reliability. Figure 17 and Figure 18 on page 47 show some ways the 4-port 100 Mbps modules can be used with the 8285.

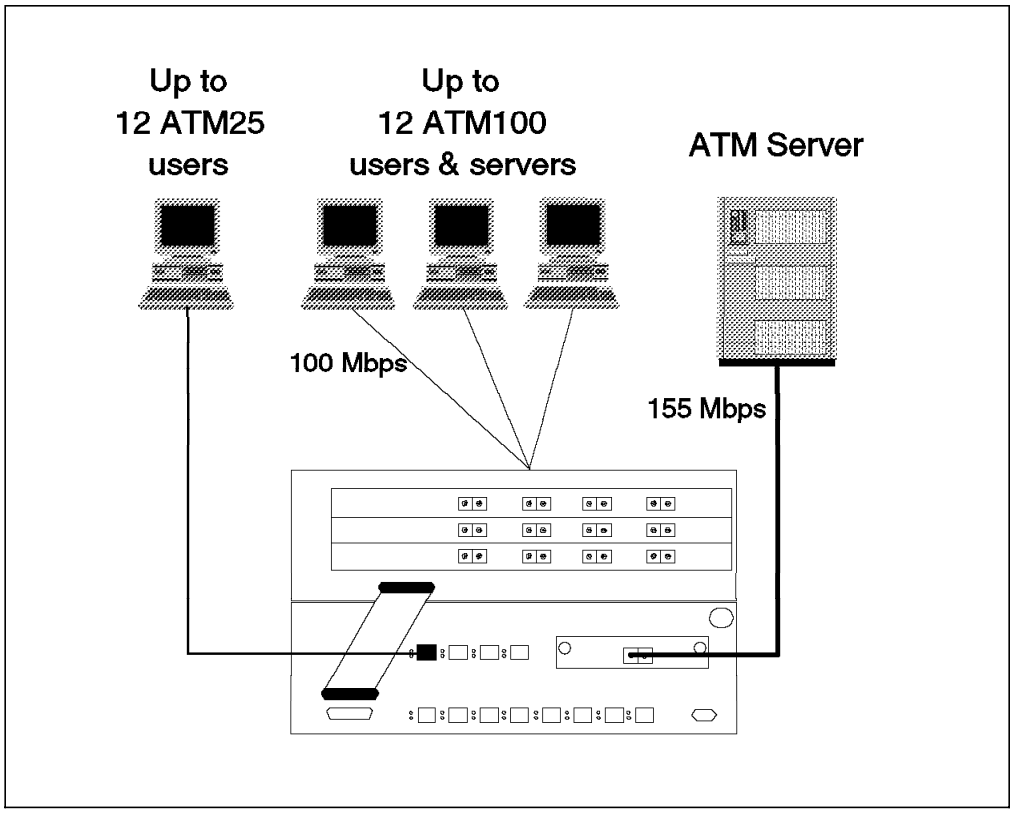

Figure 17. ATM 100 Mbps MIC/SC Fiber Module Workgroup Configuration

The first example, a workgroup configuration, shows how you might set up a very cost-effective high-performance stand-alone workgroup, providing up to 100 Mbps bandwidth to as many as 16 power users, 25 Mbps of bandwidth to as

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many as 12 ATM25 desktops, and give them all 155 Mbps access to an ATM server. When used in conjunction with IBM's Turboways 100 Mbps ATM Adapters on the workstations, performance can meet or exceed some 155 Mbps adapter/switch combinations.

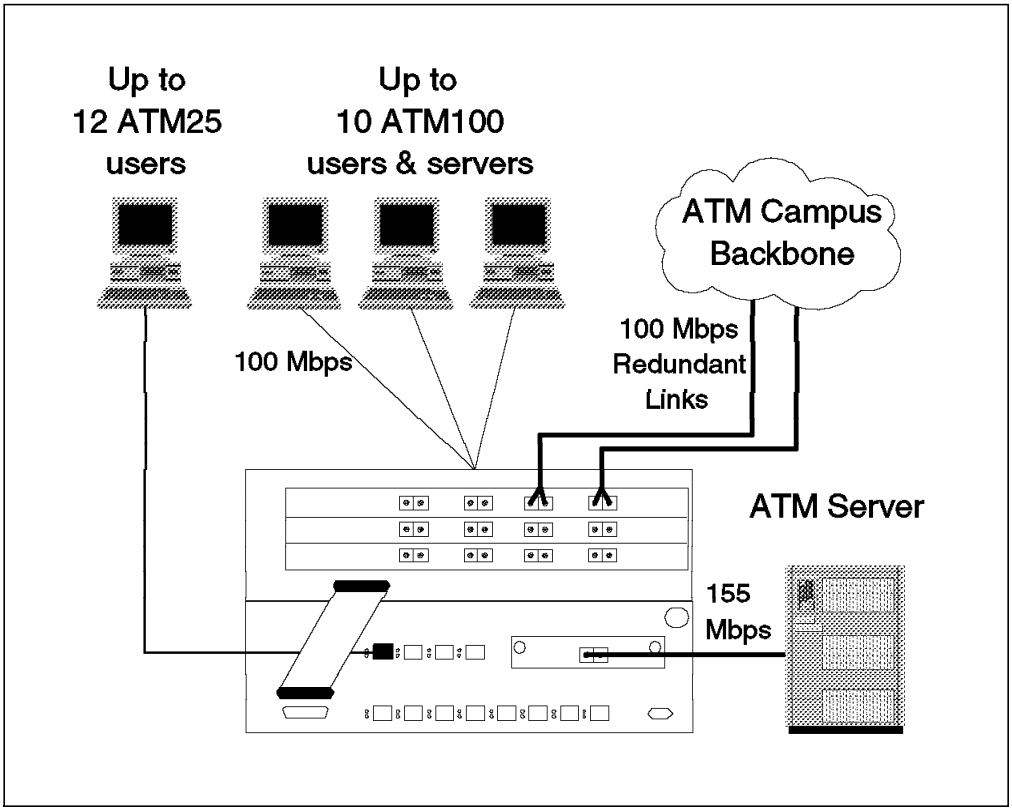

Figure 18. ATM 100 Mbps MIC/SC Fiber Module with Redundant ATM Backbone Links

The second example, above, shows how you can connect the high-performance workgroup into the backbone network to access additional high-speed resources. By implementing a second backbone link connected to a different switch in the backbone, you can provide additional bandwidth for your users and enhance the network's availability to your workgroup even if one of the collapse-point switches fails.

4.6 Video Distribution Module

The Video Distribution Module is a double-slot video concentrator module that can be used to provide low-cost, high-quality, video distribution to standard TV monitors. It has the following characteristics:

- Eight independently addressable MPEG-2 decoder ports. Each port can support an MPEG-2 video stream encoded at data rates of 1.5-15 Mbps simultaneously.
- Eight separate audio and video output connections:
  - Video: composite baseband NTSC (EIA Standard RS-170A) or PAL (in Release 1.1):
    - Video Resolutions:
      - SIF: 352x240 pixels (NTSC)
      - HHR or Half-D1: 352x480 pixels (NTSC)
      - CCIR-601 or Broadcast: 704x480 pixels (NTSC)
      - Comparable PAL resolutions
  - Audio: stereo, balanced or unbalanced
- Supports MPEG-2 Main Level, Main Profile (4:2:0) video and MPEG-1 audio.
- Supports MPEG-2 Elementary Stream or MPEG-1 Elementary Stream encapsulated in an MPEG-2 Transport Stream at speeds of up to 15 Mbps.
- Supports a Single Program Transport Stream (that is, one video and one audio program).
- Supports Closed Caption data and Extended Data Services information in accordance with *EIA 608: Recommended Practice for Line 21*.
- Supports ATM for PVC and SVC Connections using UNI 3.1.
- Can receive video input from any ATM device that can access the 8285 switch via the the ATM network.
- Supports frame synchronization using GENLOCK inputs.
- Functions as an H.310 AAL-5 Receive-Only Terminal (ROT). H.310 is an ITU standard for broadcast-quality audiovisual communication over broadband networks using MPEG-2 video over high-speed ATM networks. The standard includes subparts such as:
  - H.262 (MPEG-2 video standard)
  - H.222.0 (MPEG-2 Program and Transport Stream)
  - H.222.1 (MPEG-2 streams over ATM)
  - Various audio compression standards
- Can be monitored, but not configured via the 8285 ATM Control Point.

4.6.1 MPEG Fundamentals

MPEG-2 is an International Telecommunication Union (ITU) standard for digitizing, compressing, and multiplexing video and audio information. The predecessor to MPEG-2 is MPEG-1, which is widely used in low-end video and PC software-based encoding and decoding environments. MPEG-1 is a desktop

quality, low bandwidth, and low resolution standard with fixed limited rates. MPEG-2 expands upon MPEG-1 in all directions:

- Higher quality (at the expense of higher bandwidth requirements)
- Higher resolutions (up to HDTV levels)
- Tremendous flexibility in compression rates.

MPEG-2 provides the standard for high-quality motion video compression. It is accepted by all segments of the entertainment, broadcasting, and video editing industry.

4.6.1.1 MPEG-2 Data Streams

MPEG-2 allows for the multiplexing of many independent audio and video streams (called *Elementary Streams*) into a *System Stream*, with synchronization information and audio/video correlation information.

There are two types of system stream:

1. Program data stream

   This is suitable in environments where reliable storage is ensured.

2. Transport data stream

   This is designed to transmit audiovisual content over networks.

   The MPEG-2 transport data stream carries video and audio in the same data stream within separate fields. All video and audio material is stamped with presentation time stamps at the time of encoding. These time stamps are synchronized during the decoding process. This ensures synchronization of data without perceivable jitter.

4.6.1.2 Multiplexing and Synchronization

MPEG-2 defines a *system layer* that provides the ability to multiplex and synchronize multiple video and audio streams, and other private data. The system layer includes clocking information between the encoder and decoder. Even when an MPEG-2 stream is stored, the decoder may read the clock values to accurately recreate the motion picture.

The system layer also removes storage and transmission dependencies from MPEG-2. Since the system layer is self-clocking, MPEG-2 does not require synchronized transmission lines. Error checking fields add robustness to the transmission layer.

In comparison, there is no standardized system layer for M-JPEG. Therefore, it must record and transmit video and audio separately. The lack of a standard prevents M-JPEG encoded material from being freely exchanged. It cannot be recorded for future playback due to the absence of built-in timing information. M-JPEG requires a synchronous transmission line, that is, a more expensive communications network.

4.6.1.3 Motion Interpretation and Improved Compression

MPEG-2 interprets motion between successive images and takes advantage of motion to improve compression while sustaining the same level of perceived image quality. The MPEG-2 motion interpretation uses a combination of two kinds of frames to do this:

- An anchor frame:
  - Intra-Frame (I-Frame):
    - Only exploits spatial redundancy to compress information within the frame
    - Contains all information to reconstruct the image; does not depend on another frame
- A difference frame, which can be either:
  - Predictive Frame (P-Frame):
    - Exploits temporal and spatial redundancy to compress video frame
    - Must reference a previous anchor frame to reconstruct the image
    - Can be anchors to other P or B frames
  - Bidirectionally Predictive Frame (B-Frame)
    - Exploits temporal and spatial redundancy to compress video frame
    - Must reference an anchor frame
    - Cannot be an anchor to another frame

A typical encoded frame sequence might look like the one in Figure 19 on page 51.

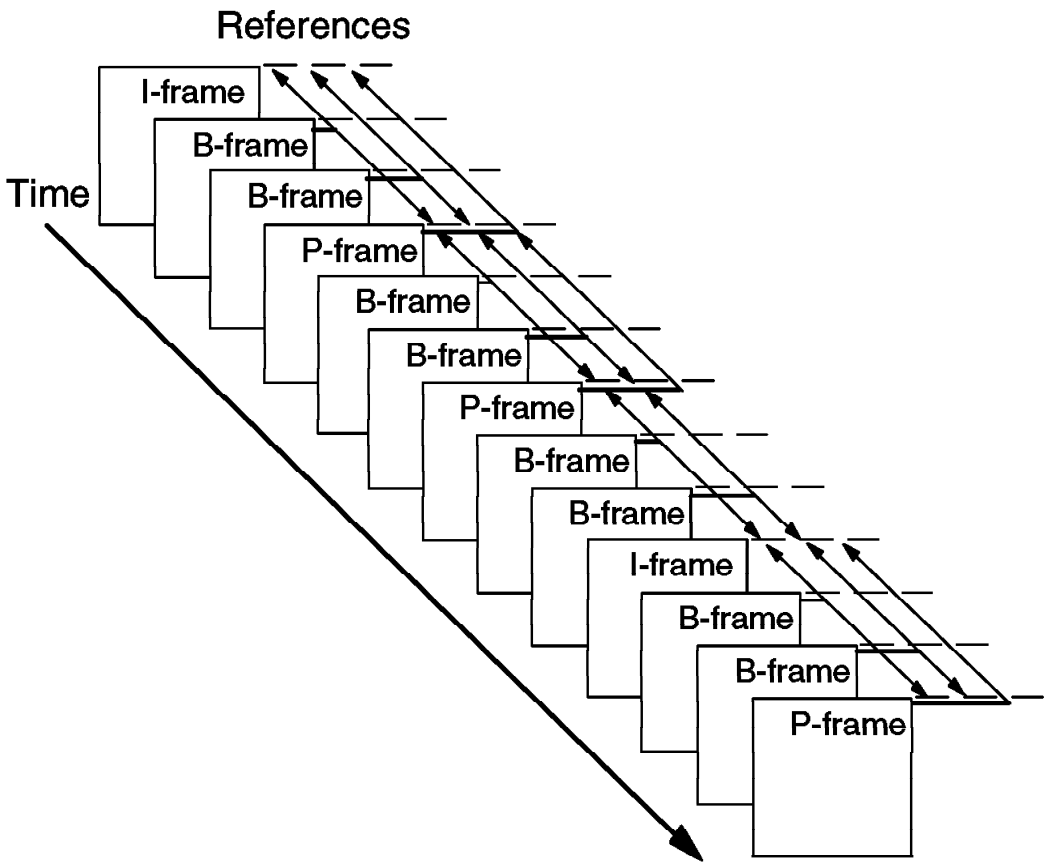

Figure 19. Typical MEPG-2 Picture Sequence Showing Picture Types

Since the anchor frame is sent only intermittently, and only changes are sent for the intervening frames, significant bandwidth savings can be realized, with minimum degradation of picture quality. It should be noted, however, that response time may be unacceptably affected in some situations when using full IPB compression. This can be remedied by using just I and P frames, resulting in similar delays to M-JPEG but requiring much less bandwidth.

4.6.1.4 Audio Compression

The MPEG-2 system multiplex layer allows for various audio compression standards to be used, and the definition of a standard compression scheme ensures compatibility between vendors. In comparison, M-JPEG does not include an audio standard. Audio is transmitted separately from the video.

4.6.1.5 MPEG Summary

MPEG-2 is superior to M-JPEG because of its ability to multiplex and to synchronize, to interpret motion and to provide improved compression, and to transport multiple different audio compression data streams.

Table 4 on page 52 provides a convenient comparison of the two technologies.

Table 4. Video Distribution Module Comparison of MPEG-2 and Motion-JPEG

Feature	MPEG-2	M-JPEG
System Layer	Provides audio and video synchronization.	No system layer, that is, no standard synchronization method.
Record on Servers	Yes	Must record video and audio separately, leading to synchronization problems.
Motion Compression	Yes	No
Standard Auto Compression	Yes	No
Compression Algorithm	DCT	DCT
MPEG-1 Compatibility	System layer can carry MPEG-1. MPEG-2 equipment downward compatible with MPEG-1.	No
Private Data for Closed Captioning	Yes	No
Bandwidth Requirements for High Quality Video	**I-Frame** Less than 18 Mbps. **I+P Frame** Less than 12 Mbps. **IPB Frame** Less than 6-8 Mbps.	20 Mbps
ATM Compatibility	MPEG-2 Transport Streams can be carried over AAL5 and can take advantage of variable bit rate services.	Requires circuit-switched, constant bit rate (AAL1) services for accurate voice and video synchronization.
Standardization	MPEG-2 video and MPEG-1 audio encoding are standard. H.310 encompasses MPEG-2 and defines operational specifications for MPEG-2 over ATM video conferencing.	Video conferencing and transmission using M-JPEG is not standardized. Proprietary implementations cause interoperability problems.

4.6.2 Configuring the Video Distribution Module

The Video Distribution Module is a relatively simple module to configure since it is merely a target for an ATM stream from another source. The process is as follows:

- Enable the VDM port as a UNI interface:

  In the following example:

  – The second port of the VDM for our video output is set.

- VPI 4 and VCI 10 values are used.
- UNI signalling is set.
- Flow control is disabled.
- ILMI handshaking is disabled, forcing UNI 3.1 signalling.

```
8285> set port 3.2 disable
8285> set port 3.2 enable vpi_vci:4.10 uni flow_control:off ilmi:off_sig_3_1
```

- Configure one PVC between the VDM port and the video source port, either local or remote, using the SET PVC command:

```
SET PVC local_slot.port pvc_id remote_slot.port remote_hub_number path_type
        local_vpi remote_vpi bw_alloc bandwidth
```

local_slot.port The slot and port number for a local end of the PVC.

pvc_id This allows you to define multiple PVCs per port.

remote_slot.port The slot and port number for the other end of the PVC.

remote_hub_number
The hub number (13th byte of the ATM address) of the other hub. Can match the local hub number for local PVCs.

path_type Specifies the type of virtual path connection.

local_vpi The vp.vc value for the local end of the PVC. See Table 5 for allowable values.

remote_vpi The vp.vc value for the other end of the PVC. See Table 5 for allowable values.

bw_alloc The bandwidth allocation algorithm to be used:
- BEST_EFFORT
- RESERVED_BANDWIDTH

bandwidth The amount of bandwidth to allocate, if bw_alloc has been set to RESERVED_BANDWIDTH.

Table 5. VC Values by Port for VDM Module (VP=0)

Port	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
VC Value	32	33	34	35	36	37	38	39

With the following command, the video source, an IBM 8300 Video Access Node is directly connected to the 155 Mbps port on the base unit.

```
8285>set pvc 1.13 1 3.2 02 channel 0.33 0.33 best-effort
```

Reminder

Remember that the vpi.vci pairs that you specify must match those configured in the devices at each end of the PVC. In this case, the VDM forces values of 0.32, 0.33, etc., but your source device must be configured to match the vpi.vci values that you configured above.

4.6.3 Sample Scenarios

The Video Distribution Module is designed to provide cost-effective distribution of video and audio programs, either real-time or from a server, to either a workgroup or an ATM network.

It is ideal for such applications as distance learning, online education, and real-time news updates. Figure 20, Figure 21 on page 55, and Figure 22 on page 56 show some ways the Video Distribution Module can be used with the 8285 switch

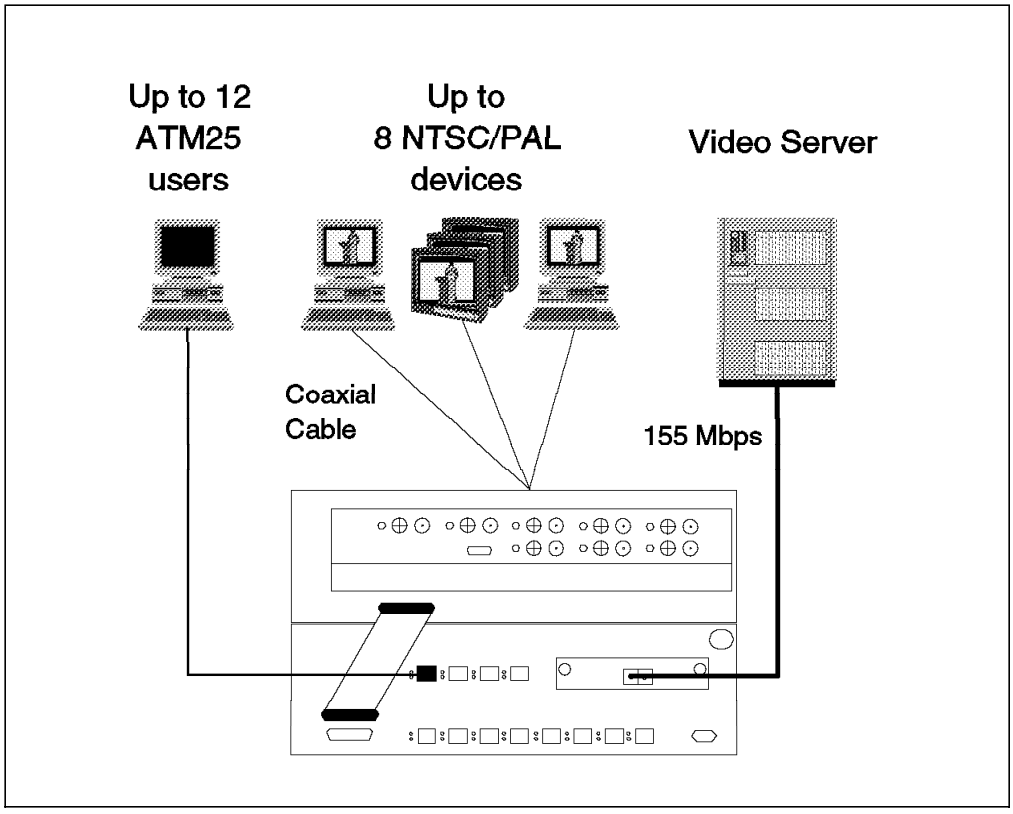

Figure 20. Video Distribution Module Workgroup Configuration

The first example, a workgroup configuration, shows how you might set up a very cost-effective stand-alone workgroup, providing video distribution from a video server to a group of users (with video connections) and/or TV monitors.

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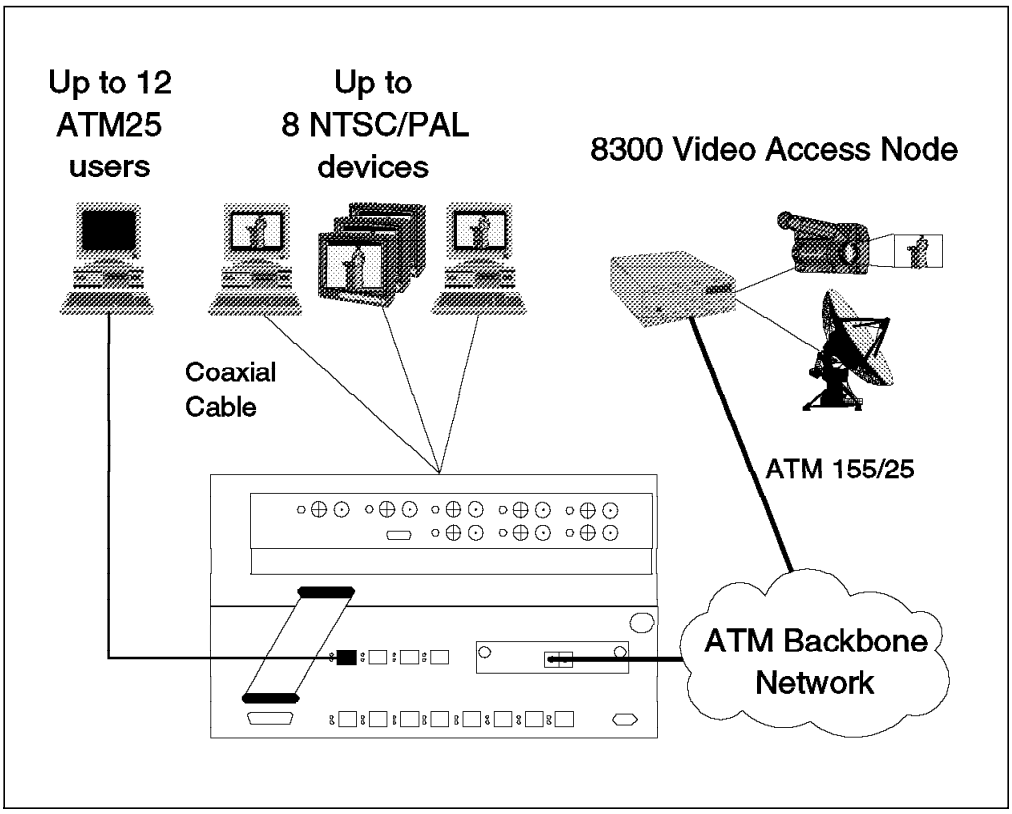

Figure 21. Video Distribution Module for Campus Video Distribution

The second example shows how you can connect the workgroup into the backbone network to access additional video resources such as TV feeds and video servers, such as the IBM 8300 Video Access Node.

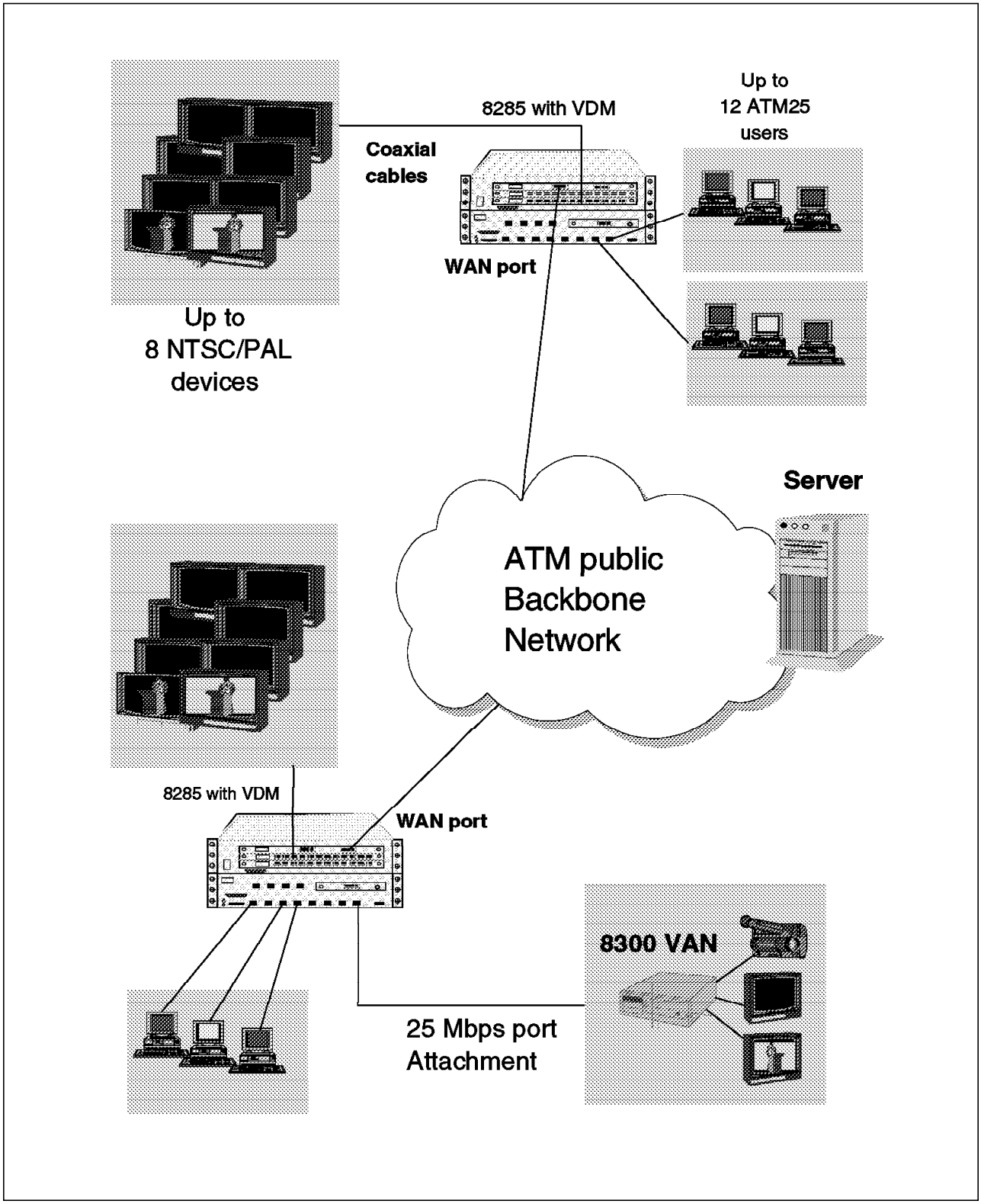

Figure 22. Video Distribution Module with ATM WAN for Enterprise Video Distribution

The third example, shows how you might use the VDM module with the ATM WAN Module to provide access to video resources throughout the enterprise using publicly available ATM WAN services, accessed with the ATM WAN Module at speeds from E3 to OC-3/STM-1.

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4.7 ATM 4-Port TR/Ethernet Bridge Module

The ATM TR/Ethernet Bridge Module is a two-slot module that functions as a multiport bridge providing a simple way to connect shared media LAN segments to a high-speed ATM backbone. This is an ideal way to begin a migration to an ATM backbone, especially for those customers running flat or bridged networks today, since it is completely transparent to your shared media users.

The main features of this module are:

- Provides four external ports for interconnection to either Ethernet (IEEE 802.3 and DIX V2) or token-ring (IEEE 802.5) LANs. This module does not allow the mixing of various LAN types.
- Provides media-speed bridging between all four LAN ports even when configured for full-duplex token-ring.
- Provides a single UNI 3.0-compatible ATM interface to the ATM backplane of the 8285 Expansion Chassis.
- The ATM port supports clients for either Forum-compliant LAN Emulation (LANE) or IBM LAN Emulation (IBMLE). This enables traditional LAN users connected to one of the external ports to access transparently devices (for instance, servers) on a high-speed ATM ELAN, either LANE or IBMLE.

  Note

  The emulated LAN must be the same type of LAN as the one used on the four LAN ports. This means that the ATM 4-Port TR/Ethernet Bridge Module cannot be used to connect Ethernet devices to token-ring devices across an ATM network. However, such connectivity can be provided when the ATM TR/Ethernet Bridge Module is used in conjunction with an ATM router such as the IBM Multiprotocol Switched Services Server

- Supports standard source route bridging (SRB) when the ports are configured to use token-ring. This enables easy migration from existing token-ring backbones to high-speed ATM backbones.
- Supports transparent bridging when the ports are configured to use Ethernet.
- Supports 256 virtual circuits (VCs) over the ATM connection.
- Supports both Generic Flow Control (GFC) and Operation and Maintenance/Flow 5 (OAM-5) to throttle traffic in a congestion situation.
- Supports powerful, flexible filtering of inbound LAN traffic:
  - In the token-ring environment, filters can be based on:
    - Hop count
    - MAC address
    - Ring number
    - Source service access point (SAP)
    - Subnetwork access protocol (SNAP)
  - In an Ethernet environment, filters can be based on:
    - MAC address
    - Source service access point (SAP)
    - Ethertype

These filters can be activated and prioritized at both the bridge level and the port level to provide even greater control over your network traffic.

- Comes with an easy-to-learn, easy-to-use graphical configuration program to simplify the task of configuring and managing the bridge module.
- Management of the ATM LAN Bridge module is done using SNMP. The SNMP agent within the module supports various MIBs.

Note

The SNMP agent in this module is accessible via IP over any of the ATM or LAN ports. Since the ATM port supports only LANE or IBMLE, any ATM-attached management station must support LANE or IBMLE. This implies that ATM-attached stations using Classical IP over ATM (RFC 1577) cannot communicate with this module directly over ATM. However, an ATM router, such as the IBM Multiprotocol Switched Services Server, can interconnect ELANs running CIP and LANE, and provide SNMP access at the IP layer.

4.7.1.1 LAN Ports

The ATM TR/Ethernet Bridge Module has four LAN ports that can be configured (via the configuration program) to be used either as token-ring or as Ethernet ports.

Ports 1 and 3 on the module are always accessed via an RJ-45 interface for both token-ring and Ethernet.

Ports 2 and 4 can be accessed via the following interfaces:

- An RJ-45 interface that can be used by token-ring or Ethernet
- An AUI interface that can be used by Ethernet only

4.7.1.2 ATM Port

The ATM port on the ATM-LAN bridge does not have an external interface and communicates with the switch-on-a-chip and the 8285 ATM Control Point via the ATM backplane in the 8285 Expansion Chassis. The ATM interface complies with UNI 3.0 specifications.

4.7.1.3 RS-232 Console Port

In addition to the LAN ports, the ATM TR/Ethernet Bridge Module has an RS-232 console port (also known as a service port). The service port enables you to connect a workstation to the ATM TR/Ethernet Bridge Module to load new configuration, microcode, etc.

Note: After the initial configuration, you can also access the ATM TR/Ethernet Bridge Module inband through LAN or ATM ports to load new configuration, microcode, etc.

4.7.2 Sample Configurations Using ATM TR/Ethernet Bridge Module

The following sections show you some examples of using the ATM 4-Port TR/Ethernet Bridge Module.

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4.7.2.1 Local LAN to LAN Server Bridging

Figure 23 shows an example of using the ATM-LAN bridge as a means of bridging three token-ring LANs together while providing all users, including the ATM25 users, with access to a LAN server. Note the console connects to the base unit and to the bridge module; this is required for the initial configuration of the bridge module.

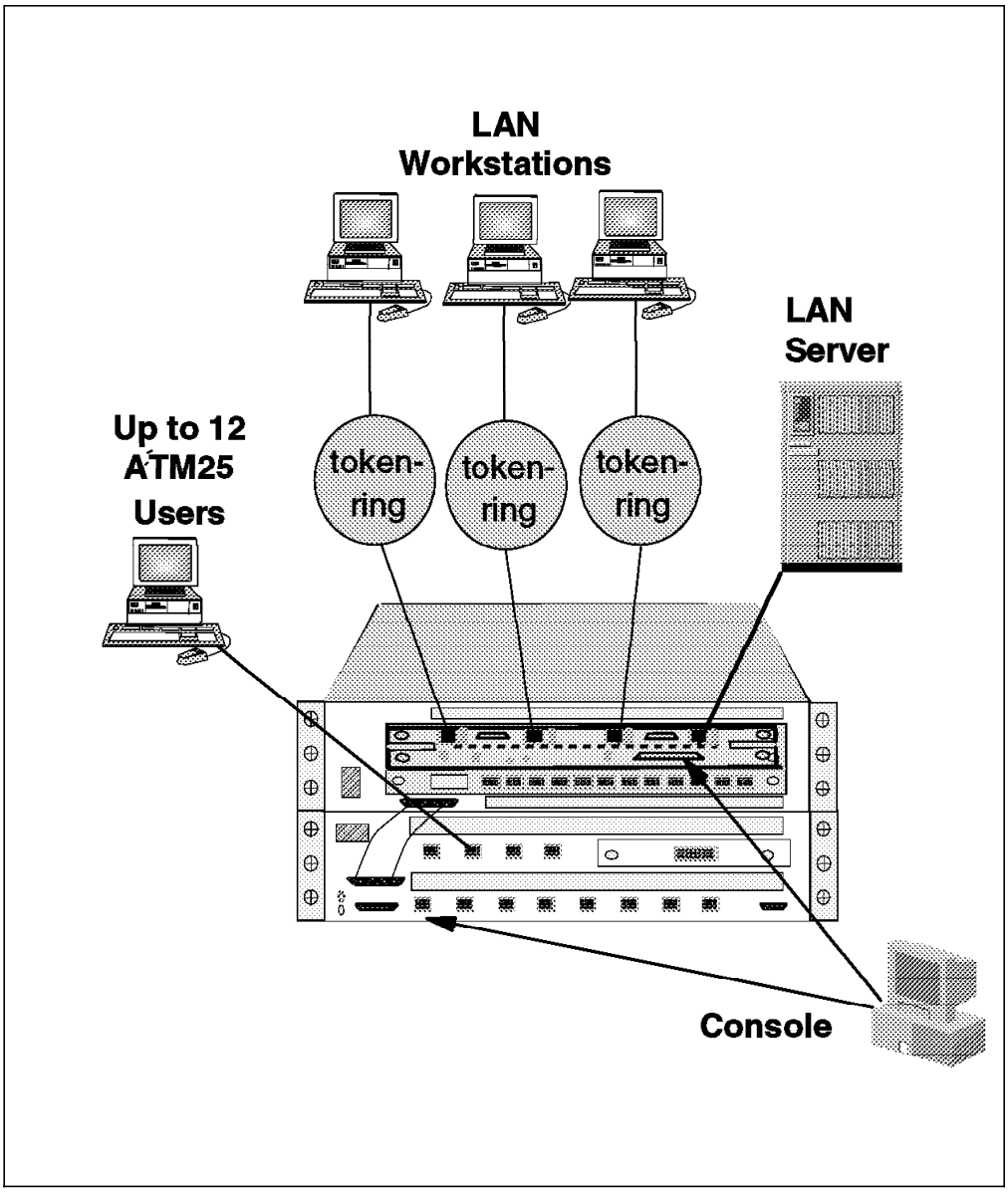

Figure 23. Local LAN to ATM Server Bridging

Figure 24 on page 60 shows an example of using the ATM-LAN bridge as a means of bridging three Ethernet LANs together while providing all users, including the ATM25 users, with access to both a LAN server and to an ATM-attached server for very demanding applications.

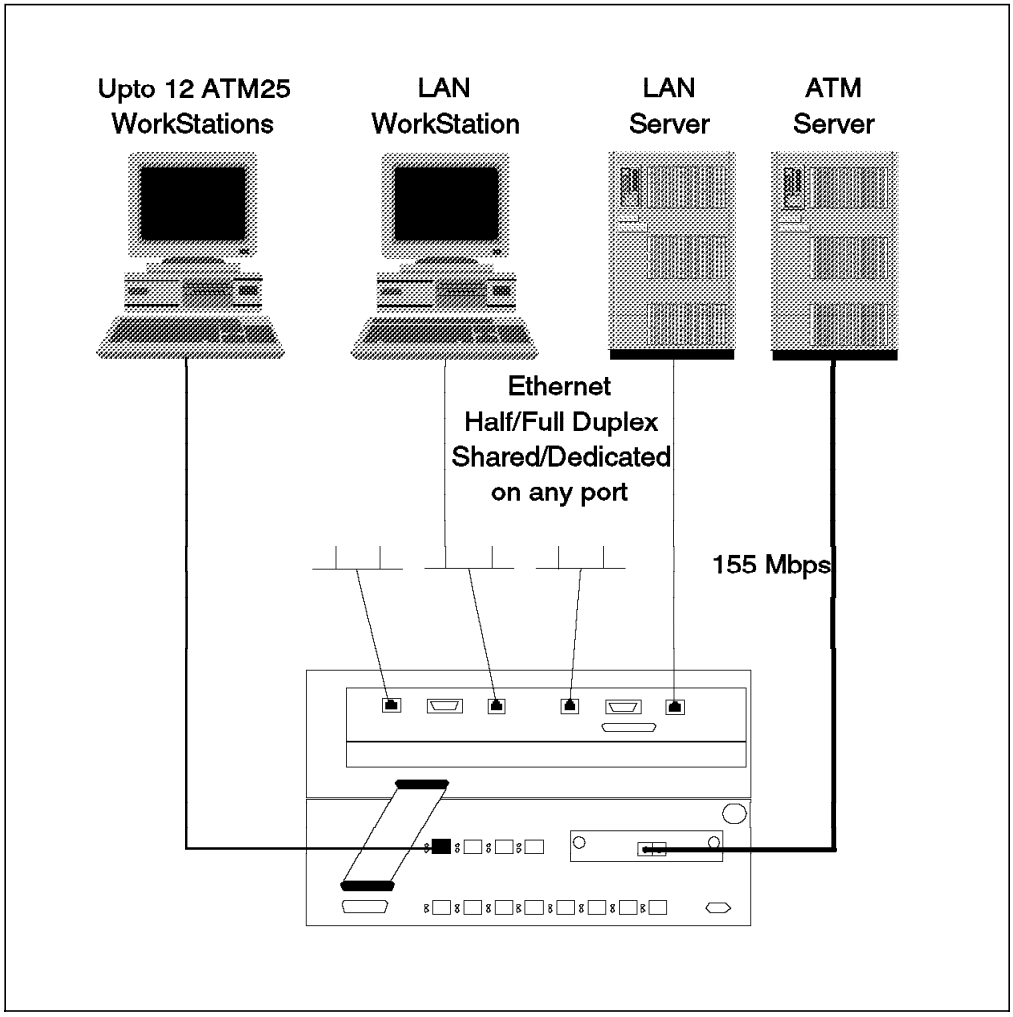

Figure 24. Local LAN Bridging and ATM Server Access

4.7.2.2 Campus LAN Interconnect and ATM Server Access

Figure 25 on page 61 shows an example of using the ATM-LAN bridge as a means of bridging four LANs together with four LANs remotely, interconnecting them with a high-speed ATM backbone while providing all users, including the ATM25 users, with access to an ATM-attached server for very demanding applications.

Note

All LANs configured on a specific module must be of the same type, Ethernet or token-ring. Moreover, the workstations connected to that port will only be able to communicate directly with other devices supporting that same kind of LAN type, whether natively (via another ATM/LAN bridge), or via LAN emulation. This limitation can be overcome using an ATM router such as the IBM Multiprotocol Switched Services Server.

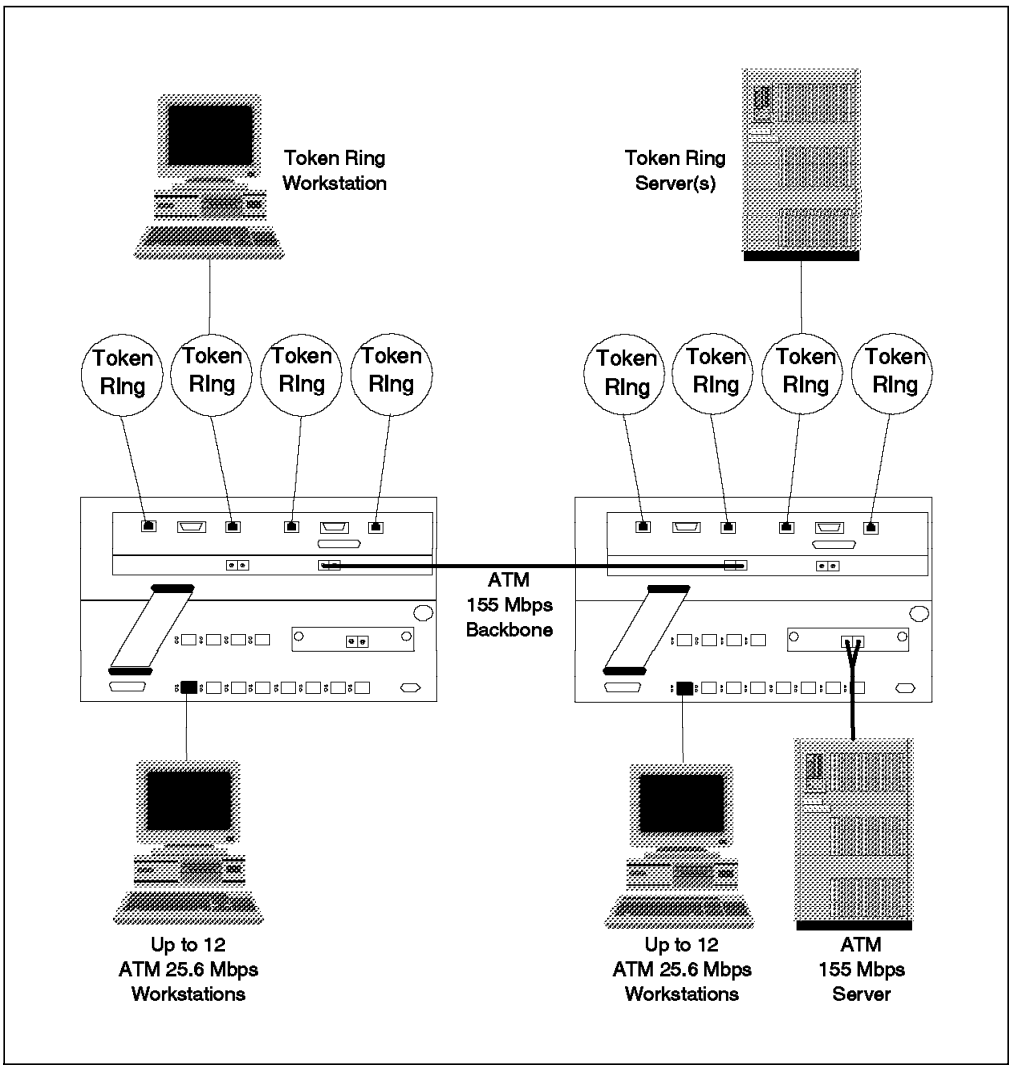

Figure 25. Campus LAN Interconnect and ATM Server Access

4.7.3 ATM TR/Ethernet Bridge Module and LAN Emulation

The ATM TR/Ethernet Bridge Module provides connectivity between traditional LANs (token-ring or Ethernet) and ATM networks by sending LAN frames transparently over the ATM network using LAN emulation to resolve MAC-to-ATM addresses.

The IBM LAN emulation service allows the ATM network to emulate the services of either a token-ring or an Ethernet LAN. The LAN emulation service is provided jointly by a LAN emulation server (LE server) and the LAN emulation client (LE client) software running in the device attached to the ATM network.

As an LE client, the ATM TR/Ethernet Bridge Module is able to find the correct ATM destination, to set up the connection, and to switch LAN traffic to that destination on behalf of a LAN endstation. It is self-learning, meaning that it is able to discover its ATM partners and to establish connections on an as-needed basis.

4.7.4 Association between IP and MAC Address

The ATM TR/Ethernet Bridge Module can be reached via four LAN ports and/or one ATM port, but it has only a single IP address that is assigned to it at the time of configuration. This IP address will be associated with the first port on the ATM TR/Ethernet Bridge Module that connects to a network successfully. If more than one port is configured for the ATM TR/Ethernet Bridge Module, there will be a race condition to determine which port is associated with the IP address.

The MAC address of the port associated with the IP address will be used in the response to the ARP requests sent to the IP address of the ATM TR/Ethernet Bridge Module, regardless of the port on which the ARP request is received. If the port which is associated with the IP address of the ATM TR/Ethernet Bridge Module becomes disabled (say the cable is disconnected), the IP-to-MAC address association will remain unchanged. This means that the ATM TR/Ethernet Bridge Module will still respond to ARP requests with the MAC address of the port that was initially associated with the IP address of the ATM TR/Ethernet Bridge Module. This ensures that the ARP table entry in the stations that communicate with the ATM TR/Ethernet Bridge Module via the IP will still be valid regardless of the fact that the port with that MAC address may be down.

If the ATM TR/Ethernet Bridge Module is reset and the MAC address of another port is associated with the IP address of the ATM TR/Ethernet Bridge Module, the ARP table entry in the stations that were communicating with the ATM TR/Ethernet Bridge Module will become invalid. Those stations will not be able to communicate with the ATM-LAN Bridge module via IP until their ARP table entry is aged-out or is deleted by the user to allow the IP station to discover the new MAC address associated with the ATM TR/Ethernet Bridge Module. Therefore, if you have problems communicating with the ATM TR/Ethernet Bridge Module via IP, one of the first things that you can do is to delete the ARP entry in your IP workstation to enable it to rediscover the ATM TR/Ethernet Bridge Module via the ARP process.

4.7.5 ATM TR/Ethernet Bridge Module Configuration Utility Program

The Configuration Utility Program is a DOS/Windows-based application that enables a user to modify the ATM TR/Ethernet Bridge Module′s configuration parameters, to change the operating code, and to use minimal mode. The following is the list of the functions that can be performed using the Configuration Utility Program:

- Create a bridge profile
- Edit a bridge profile
- View a bridge profile
- Save a bridge profile to the hard disk
- Delete a bridge profile from the hard disk
- Send a bridge profile to the ATM TR/Ethernet Bridge Module
- Retrieve current configuration parameters from an ATM-LAN Bridge Module
- Load new operational parameters from an ATM-LAN Bridge Module
- View vital product data (VPD) for an ATM TR/Ethernet Bridge Module
- Erase the configuration for an ATM TR/Ethernet Bridge Module

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- Perform a memory dump of the ATM TR/Ethernet Bridge Module

To install the Configuration Utility Program, insert the diskette that contains the program in the diskette drive in your workstation, start Windows, and select **Run** from the Program Manager File menu. This procedure starts the execution of the install.exe file from the diskette, which installs the Configuration Utility Program. When the installation is complete, the ATM TR/Ethernet Bridge Module configuration group will appear as an icon on the Program Manager window (see Figure 26).

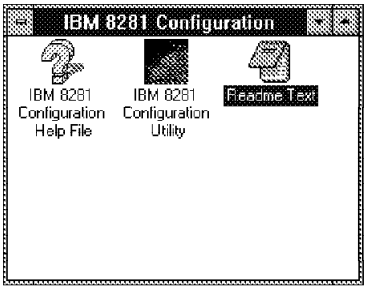

Figure 26. ATM TR/Ethernet Bridge Module Configuration Window

To use the Configuration Utility Program to manage the ATM TR/Ethernet Bridge Module, the workstation running this program must be able to access the ATM TR/Ethernet Bridge Module either via the service port or through a LAN or ATM port.

To use the service port, the workstation must be directly attached to the serial EIA 232 port (labeled service on the ATM TR/Ethernet Bridge Module, see Figure 27 on page 64) and must use the Serial Line Internet Protocol (SLIP) to communicate with the ATM TR/Ethernet Bridge Module. Therefore, make sure that the TCP/IP protocol is running in the workstation, and that SLIP is correctly set up in the TCP/IP configuration.

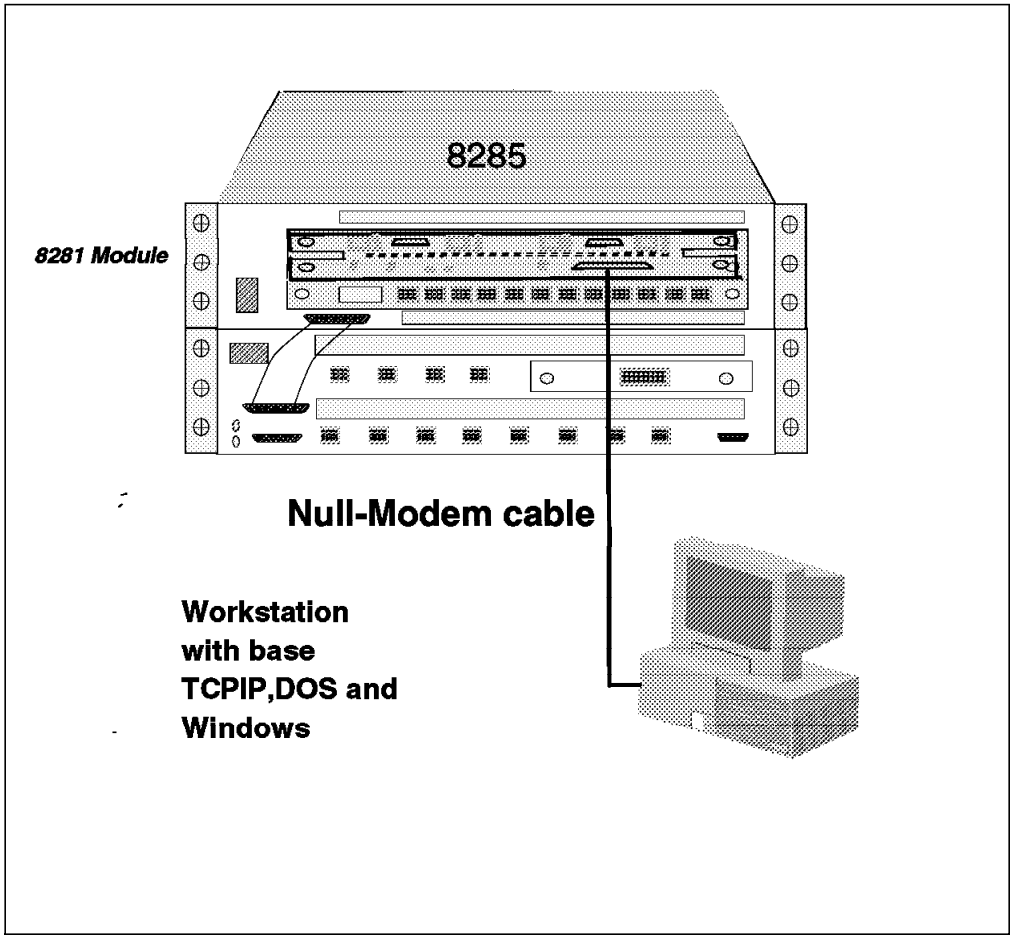

Figure 27. The ATM TR/Ethernet Bridge Module Service Port Connection

To access the ATM TR/Ethernet Bridge Module via a LAN or ATM port, the workstation running the Configuration Utility Program must have IP connectivity through the network (either directly or through bridges, routers, etc.) to be able to reach the ATM TR/Ethernet Bridge Module's LAN or ATM port. In this case, the TCP/IP stack in the workstation must be configured to provide such a connectivity.

Note: At the initial startup of the ATM TR/Ethernet Bridge Module, you must use the direct connection to access the module in order to load a valid configuration. After that, you may use either direct or LAN/ATM connections to access the ATM TR/Ethernet Bridge Module for subsequent configurations.

The Configuration Utility Program provides a set of windows that allow you to configure and manage the ATM TR/Ethernet Bridge Module. Figure 28 on page 65 shows how you can navigate between various windows provided by the Configuration Utility Program.

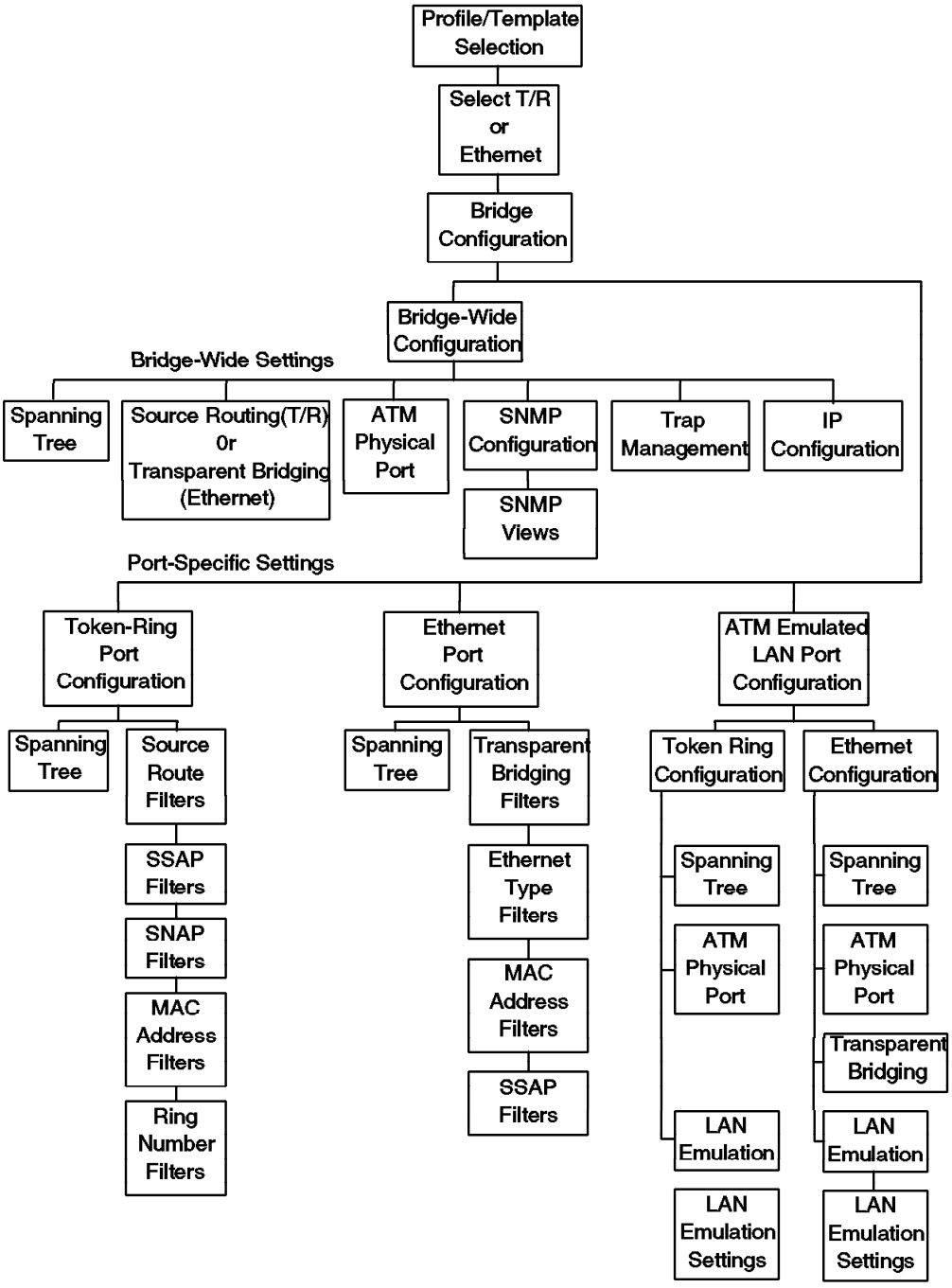

Figure 28. Windows Displayed by the ATM TR/Ethernet Bridge Module Configurator

For more information about how to install and use the Configuration Utility Program, please refer to *Nways 8285 ATM TR/Ethernet LAN Bridge Module: Installation and User's Guide*, SA33-0361.

4.7.6 Running and Stored Configuration Parameters

When the ATM TR/Ethernet Bridge Module is running, there are always the following two sets of parameters stored:

- Running parameters

  These are the parameter values that are in use by the operational code.

- Stored parameters

  These are the parameter values that exist in FLASH memory and are used only during the startup.

The stored parameters in the FLASH memory can be changed using the Configuration Utility Program by downloading new values for the configuration parameters. This can be done by creating a file of new parameter values (called profile) and sending this file to the ATM TR/Ethernet Bridge Module. To use new parameters as the running parameters, you need to restart the ATM TR/Ethernet Bridge Module.

Once the ATM TR/Ethernet Bridge Module is in operational mode, you can only view and change the stored parameters using the Configuration Utility Program. To view and change the running parameters, you must use an SNMP management station.

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4.8 ATM WAN Module

The ATM WAN Module is a single-slot WAN concentrator module that has the following characteristics:

- Provides wide-area access to campus ATM networks at speeds ranging from E3 (34.368 Mbps) to OC3/STM-1 (155.520 Mbps), when the bandwidth management capabilities of an external ATM WAN switch are not desired.
- Supports switch-to-switch and switch-to-server connections at speeds up to OC3/STM-1.
- Interfaces directly to the circuit installed by your service provider.
- Supports both UNI and NNI.
- Supports reserved bandwidth (RB) service (QOS class 1 under UNI 3.0).
- Is hot-pluggable in any available slot in the 8285 Expansion Chassis.
- Supports both internal and external clocking.
- Up to 3 ATM WAN Modules can be supported in the 8285 Expansion Chassis, providing up to 6 ATM WAN ports.
- Features four standard interfaces:
  - Two backplane interfaces:
    - An ATM backplane interface, which enables both data and control flows to the switch-on-a-chip and the 8285 ATM Control Point, respectively.
    - A standard tri-channel interface, which provides power and other control signals.
  - Two I/O interfaces, which enable the attachment of any combination of the following I/O cards:
    - 1-port E3 I/O card (E3: 34.368 Mbps) BNC interface
    - 1-port DS3 I/O card (DS-3/T3: 44.736 Mbps) BNC interface
    - 1-port OC3 I/O card (SMF) (OC3: 155.520 Mbps) SC interface
    - 1-port OC3 I/O card (MMF) (OC3: 155.520 Mbps) SC interface
    - 1-port STM1 I/O card (SMF) (STM-1: 155.520 Mbps) SC interface
    - 1-port STM1 I/O card (MMF) (STM-1: 155.520 Mbps) SC interface

    For each of these cards, the receive port is the left one, and the transmit port is the right one.

4.8.1 A02 WAN ATM Physical Interface Supported

The following table lists the ATM physical interfaces with WAN module interfaces supported:

Table 6 (Page 1 of 2). ATM Physical Interface Support

Layer	Rate (Mbps)	Cable	Coding	A02 WAN Support
OC-48	2488	SMF	STS-48	No
OC-24	1244	SMF	STS-24	No
OC-12	622.08	SMF	STS-12c	No

Table 6 (Page 2 of 2). ATM Physical Interface Support

Layer	Rate (Mbps)	Cable	Coding	A02 WAN Support
STS-12c	622.08	UTP-5	(4 pairs)	No
OC-3/STM-1	155.52	MMF/SMF	NRZI	Yes
STS-3c	155.52	MMF/SMF	NRZI	Yes
STS-3c	155.52	UTP-5/STP	NRZI	No
155	155.52	MMF	8B/10B	No
155	155.52	STP	8B/10B	No
TAXI	100	MMF	4B/5B	No
STS-1	51.84	UTP-3	CAP-16	No
DS-3/T3	44.7	Coax (BNC)	NRZI	Yes
E3	34.4	Coax (BNC)	NRZI	Yes (Note 1)
E1	2.048	Bipolar-AMI	NRZI	No
T1	1.544	Bipolar-AMI	NRZI	No
25	25.6	UTP/STP	4B/5B	No

Note 1: Country Homologation dependency.

4.8.2 VPD Installation Considerations

Each I/O card ships with a special VPD (vital product data) PROM (Programmable Read-Only Memory) chip. Before you can install the A02 WAN module, you must attach the I/O cards and install the VPD chips. Details on the installation process can be found in *IBM 8260/8285 ATM WAN Module: Installation and User's Guide*. The following are a few additional considerations:

- The VPD PROM sockets are next to their respective I/O cards. That is, the left (or top) socket is matched with the left I/O card, while the right (or bottom) socket is matched with the right I/O card. Arrows have been placed on both sockets pointing to their respective I/O cards.
- There is only one correct way to insert the VPD PROM in each socket. This can be done by aligning the notch on the chip with the notch on the socket. However, inserting the chip backwards will not damage it; the port simply will not be able to register properly with the 8285 ATM Control Point. Reversing the chip should solve the problem.
- Any VPD PROM that ships with an A02 WAN I/O card can be used with any of the other I/O cards without affecting card function. However, the card will not be listed properly in the configuration, which could be very confusing to someone managing the network. It is *strongly advised* that you carefully match the VPD PROM part numbers with their respective I/O cards as listed in Table 7 on page 69

Table 7. A02 WAN I/O Card VPD Part Numbers

Card Name	Feature Code	Part Number	VPD Part Number
1-port E3 I/O card	8501	51H4335 51H4604 (Switzerland) 51H4605 (Sweden) 51H4605 (UK) 51H4606 (New Zealand)	51H4570
1-port DS3 I/O card	8502	51H4338	51H4571
1-port OC3 I/O card (SMF)	8503	51H4558	51H4572
1-port OC3 I/O card (MMF)	8504	51H4673	51H4852
1-port STM1 I/O card (SMF)	8505	51H4557	51H4573
1-port STM1 I/O card (MMF)	8506	51H4674	51H4853

4.8.3 Sample Scenario

The ATM WAN Module is designed to provide high-speed access to the WAN network for all 8285-attached devices, whether native ATM or connected via the ATM 4-Port TR/Ethernet Bridge Module.

Figure 29 on page 70 shows some ways the ATM WAN Module can be used with the 8285.

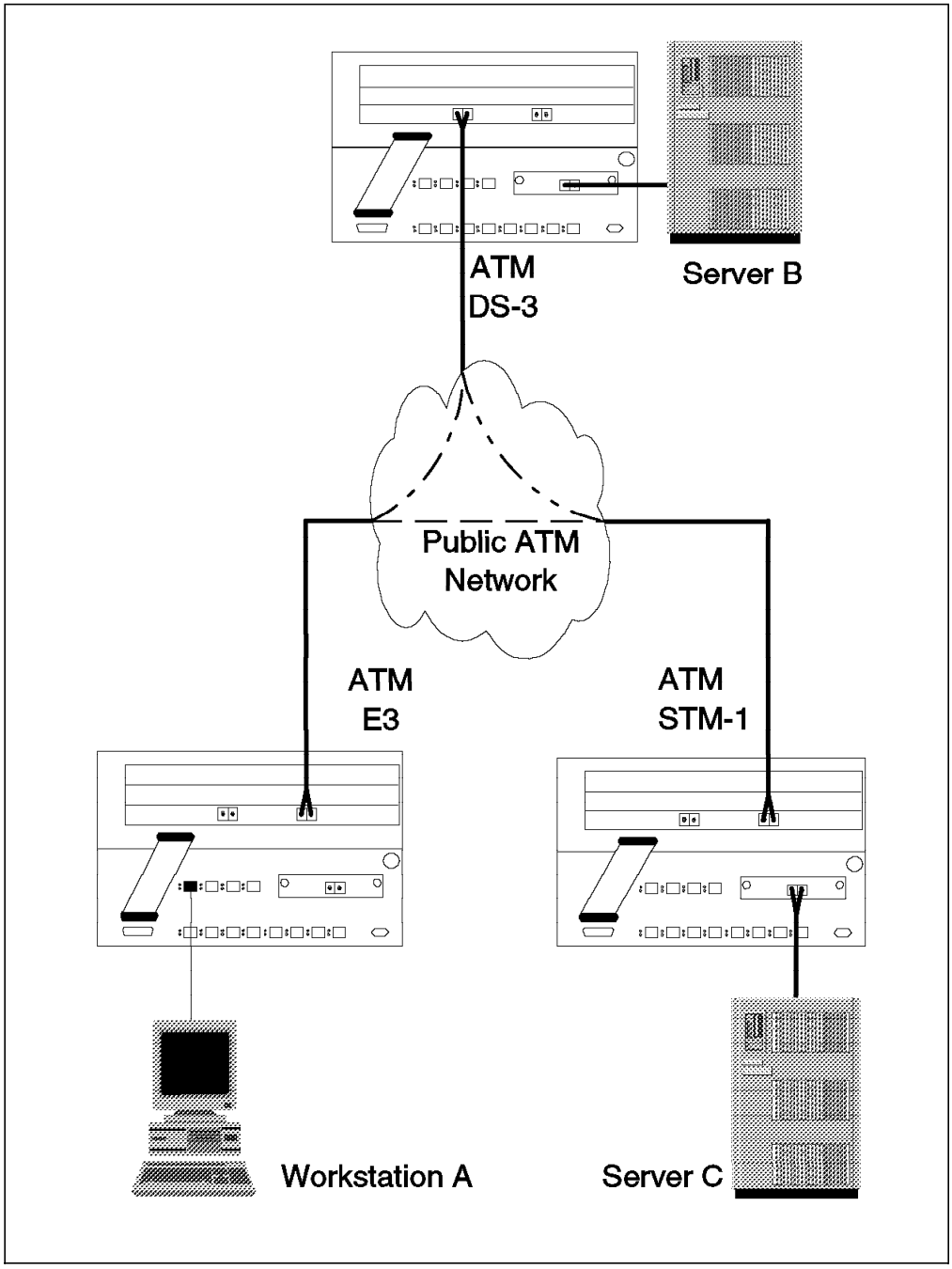

Figure 29. A Typical ATM WAN Module Configuration

The scenario depicts a possible client/server environment in which the workstation must access both servers, and in which both servers must exchange information such as files and images. The ATM WAN Module allows each site to access the common backbone network at the most cost-effective speed, from E-3 for the workstation to DS-3/T3 and even STM-1/OC-3 for the servers.

4.9 LAN Switching Modules

Attention

The following section is included as a preview of module support that might become available in 1997.

The 8285 is capable of supporting the following LAN switching modules:

- Token-Ring:
  - 2-slot 8272 ATM/LAN Switch Module
  - 3-slot 8272 ATM/LAN Switch Module
  - 2-slot 8272 LAN Switch Module with the following:
    - 8272 LAN Switch ATM Backplane Upgrade **1**
  - 3-slot 8272 LAN Switch Module with the following:
    - 8272 LAN Switch ATM Backplane Upgrade **2**
- Ethernet:
  - 2-slot 8271 ATM/LAN Switch Module
  - 3-slot 8271 ATM/LAN Switch Module
  - 2-slot 8271 LAN Switch Module with the following:
    - 8271 LAN Switch ATM Backplane Upgrade **3**
  - 3-slot 8271 LAN Switch Module with the following:
    - 8271 LAN Switch ATM Backplane Upgrade **4**

Notes:

1 Becomes functionally identical to 2-slot 8272 ATM/LAN Switch Module.

2 Becomes functionally identical to 3-slot 8272 ATM/LAN Switch Module.

3 Becomes functionally identical to 2-slot 8271 ATM/LAN Switch Module.

4 Becomes functionally identical to 3-slot 8271 ATM/LAN Switch Module.

4.9.1 Description

The LAN switch modules that could be supported by the 8285 provide existing LAN users high-performance, cost-effective access to the ATM backbone as well as media-speed LAN switching for microsegmentation.

Direct ATM backplane connectivity allows segments of LAN users to be interconnected to other LANs users segment via LAN switching or high-speed ATM switching.

These modules feature the following:

- Common Features:
  - Support media-speed transmission on all ports simultaneously, even in full-duplex mode
  - Support half- or full-duplex transmission on each port independently

- Support port mirroring (TokenProbe or Etherprobe) whereby one port can monitor any LAN port for the purposes of connecting a LAN analysis tool
- Support three switching modes to optimize performance:

  1. Cut-Through Switching

     In this mode, the switch reads in the address portion of the frame header, makes a forwarding decision strictly based on destination address, and forwards the header and the remainder of the packet to the destination port while the packet is still arriving. This optimizes forwarding performance, but does not filter out bad frames.

  2. Store-and-Forward Switching

     In this mode, the switch reads the entire packet into a buffer and performs a full CRC check on it before forwarding good packets to the destination port. This eliminates bad frames, but with a greater latency.

  3. Adaptive Switching

     This feature allows the switch to run in cut-through mode (for high performance and low latency) until the number of bad packets received surpasses a user-settable threshold within a given period of time. It then automatically switches to store-and-forward mode to avoid propagating bad packets. When the number of bad packets falls to acceptable levels, the switch reverts automatically to cut-through mode. The net result is to give the highest possible performance with the least number of errors.

- Provides a Virtual Switch capability that allows the switch to operate as though it were actually several (up to 8) switches. That is to say, traffic arriving on a port can only be forwarded to ports within its group. This also means that broadcasts are isolated within each virtual switch.
- Support inbound MAC address filtering which allows:
  - Blocking of packet based on source or the destination MAC address.
  - Forwarding to specific ports based on source MAC address.
  - Forcing traffic to specific ports based on the destination MAC address.

- Token-Ring Features:
  - Supports 8 shielded TRN UTP/STP RJ45 lobe ports using either UTP category 3,4, or 5 cabling, or STP cabling.

    Note

    These ports do not support RI or RO connections. Use the 2-Port Fiber RI/RO UFC to handle RI or RO connections.

  - Have either two UFC slots (2-slot modules) or four UFC slots (3-slot modules), which can contain any combination of the following UFCs:
    - 4-Port UTP/STP

      This UFC adds an additional four switched TRN ports to the module.

      - Interface: RJ45
      - Cabling: STP; UTP categories 3, 4, and 5

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- 2-Port Fiber RI/RO UFC

  This UFC enables switching between token-ring segments as far as 2 km away.

  - Interface: ST
  - Cabling: Multimode fiber

- 1-Port ATM 155 Mbps Multimode Fiber UFC

  This UFC provides an ATM interface that enables token-ring attached users to interoperate with ATM-attached devices that comply with the ATM Forum LAN Emulation specifications:

  - Interface: SC
  - Cabling: Multimode fiber
  - Supports token-ring/IEEE 802.5 emulated LAN types.

- 1-Port RMON UFC

– Support up to 1792 filter table entries per port, but no more than 10,000 filter table entries per module. These filter table entries can be either MAC addresses or source-route descriptor entries. These entries can be aged-out based upon configurable parameters at the port and module level.

– Support a bandwidth aggregation feature, TokenPipe, which allows different LAN switching modules to be connected by up to four full-duplex connections, providing up to 128 Mbps of bandwidth between 8272 switching modules.

– Support source route bridging that is fully compatible with existing source route bridges.

– Support source route switching, in which frames are forwarded based on destination MAC addresses for locally attached stations and based on the routing information within the token-ring frame for non-locally attached stations (as is the case with source routing bridges to a maximum of seven bridge hops).

Note

If the module is configured for source route switching, all token-ring LAN ports *and* emulated token-ring LAN ports share the same ring number.

– Gather statistics by:

  - Port
  - Connected station
  - Switch

– Support Plug-and-Play installation by automatically initializing as a multiport transparent bridge. This allows the module to learn the network addresses and eliminates all pre-installation configuration requirements. In most cases, however, you will eventually want to customize this initial configuration with such parameters as an IP address, SNMP parameters, and port filters.

  Each port automatically identifies what kind of token-ring connection it has, determining whether it is:

- A lobe port to another concentrator
- A dedicated connection to a single device
- A connection to another token ring switch
- Operating at 4 or 16 Mbps
- Operating in half- or full-duplex mode

These automatic configuration capabilities can be disabled, for instance when connecting to an auto-speed-sensing adapter.

– Support a transparent spanning tree configuration fully compliant with IEEE 802.1d standards. This ensures that there is only one path active to any segment in the network. The spanning tree function has configurable parameters for both port cost and port priority, enabling more accurate management of your network topology.

– Support a maximum frame size of 4540 bytes. In cut-through mode, frames larger than 4540 bytes will be truncated and terminated with an abort sequence. In store-and-forward mode, the switch port will reject frames larger than 4540 bytes and will generate an error on the port.

• Ethernet Features:

– Support 12 10Base-T RJ-45 MDI-X ports using standard UTP category 3, 4, or 5 cabling or STP cabling.

Note

When using STP cabling, the patch cables at the switch port and at the workstation port should have an impedance-matching balun.

– Have either two UFC slots (2-slot modules) or four UFC slots (3-slot modules), which can contain any combination of the following UFCs:

- 4-port Ethernet 10Base-T UFC:

  This UFC adds an additional four switched Ethernet ports to the module:

  • Interface: RJ45

  • Cabling: STP; UTP categories 3, 4, and 5

- 3-port Ethernet 10Base-FL UFC:

  This UFC enables switching between Ethernet segments that are physically distant (up to 2 kilometers away) from the module:

  • Interface: ST

  • Cabling: Multimode fiber

- 1-port Ethernet 100BaseT UFC:

  This UFC provides one 100BaseT Ethernet port for a connection to a 100BaseT backbone segment or directly to a LAN station or server equipped with a 100BaseT Ethernet adapter:

  • Interface: RJ45

  • Cabling: STP; UTP categories 3, 4, and 5

- 1-port Ethernet 100BaseFx UFC:

This UFC provides one 100BaseFx Ethernet port for a connection to a 100BaseFx backbone segment or directly to a LAN station or server equipped with a 100BaseFx Ethernet adapter as far as 2 km away:

- Interface: ST
- Cabling: Multimode fiber

- 1-Port ATM 155 Mbps Multimode Fiber UFC

  This UFC provides an ATM interface that enables Ethernet-attached users to interoperate with ATM-attached devices that comply with the ATM Forum LAN Emulation specifications:

  - Interface: SC
  - Cabling: Multimode fiber
  - Supports Ethernet/IEEE 802.3 emulated LAN types.

– Support up to 1790 active Ethernet addresses per port, but no more than 10,000 addresses per module. These addresses can be aged-out based upon configurable parameters at the port and module level.

– Support a bandwidth aggregation feature, EtherPipe, which allows different LAN switching modules to be connected by up to four full-duplex connections, providing up to 80 Mbps of bandwidth between 8271 switching modules.

– Gather statistics by:

  - Port
  - Connected station
  - Switch

– Support Plug-and-Play installation by automatically initializing as a multi-port transparent bridge. This allows the module to learn the network addresses and eliminates all pre-installation configuration requirements. In most cases, however, you will eventually want to customize this initial configuration with such parameters as an IP address, SNMP parameters, and port filters.

Table 8 and Table 9 provide comparisons of the token-ring modules and the Ethernet modules, respectively.

Table 8. A Comparison of 8285 Token-Ring LAN Switch Modules

Module	**Feature**	**Maximum Number of Ports**		
		Copper	**Fiber (RI/RO)**	**ATM 155**
2-slot 8272 ATM/LAN Switch Module	5208	16	4	2
3-slot 8272 ATM/LAN Switch Module	5308	24	8	4

Table 9 (Page 1 of 2). A Comparison of 8285 Ethernet LAN Switch Modules

Module	**Feature**	**Maximum Number of Ports**				
		10Base-T	**10Base-F**	**100BaseT**	**100BaseF**	**ATM 155**
2-slot 8271 ATM/LAN Switch Module	5212	20	6	2	2	2

Table 9 (Page 2 of 2). A Comparison of 8285 Ethernet LAN Switch Modules

Module	Feature	Maximum Number of Ports				
		10Base-T	10Base-F	100BaseT	100BaseF	ATM 155
3-slot 8271 ATM/LAN Switch Module	5312	28	12	4	4	4

4.9.1.1 ATM UFC I/O Feature

There are 2 ATM UFCs available, one ATM 1-port UFC for the Ethernet LAN switches and one ATM 1-port UFC for the token-ring LAN switches.

ATM 155 Mbps UFC: The ATM Multimode Fiber UFC achieves the ATM-to-LAN connection by providing an ATM Forum-compliant LAN emulation proxy client (LEC). It features the following:

- Supports a single ATM 155 Mbps multimode fiber interface with SC connectors.
- Supports SONET STS-3c framing.
- Supports both UNI 3.0 and UNI 3.1 in accordance with ATM Forum specifications.
- Supports switched virtual connections (SVCs) only and does not support permanent virtual connections (PVCs).
- Supports best effort (Unspecified QoS), variable bit rate (VBR), and continuous bit rate (CBR) connections in accordance with ATM Adaptation Layer 5 (AAL-5) specifications.
- Supports up to 3072 virtual channel connections (VCCs), requiring one VCC for each unique source/destination LEC pair.
- Supports up to eight emulated LANs (ELANs), each represented by a logical emulated LAN port (ELP), all sharing the same physical link to the ATM network. However, it is not possible to have two ELPs assigned to the same ELAN on a single ATM UFC.
- Does not support the VPI field of the virtual path/channel identifier.
- Supports up to eight LECs which are compatible with LES/LECS Version 1.0 implementations. Each LEC can be pre-configured with the address of its required LAN Emulation Server (LES) or can discover the address of its LES dynamically via communication with a LAN Emulation Configuration Server (LECS).
- Supports full media-speed throughput in both directions on its full-duplex ATM connection, assembling or disassembling an aggregate of approximately 177 Kbps (thousand 64-byte frames per second).
- Supports the following management interfaces:
  - LEC MIB (ATM Forum LEC Management Specification Version 1.0)
  - AToM MIB (RFC 1695)
  - Interface group of MIB-II (RFC 1213 and 1573), enhanced to include ATM

  The switch′s SNMP agent is accessible though any of the Ethernet or token-ring LAN ports. When the LAN switch is configured with an ATM UFC, the switch′s SNMP agent is also accessible via an emulated LAN connection across an ATM port.

Note

If the module is configured for source route switching, all token-ring LAN ports *and* emulated token-ring LAN ports share the same ring number.

4.9.2 Sample Scenarios

The 8285 LAN switching modules complement the IBM 8285 Base Unit's cost-effective ATM25 capabilities and can serve as the basis for a smooth migration from traditional shared-media LANs to the high-performance ATM networks of the future. Here are some scenarios that could be implemented.

4.9.2.1 Stand-Alone Token-Ring Migration

In this scenario, a workgroup of 80 users and 4 servers has run out of bandwidth on its local token-ring network. A very simple way to alleviate this constraint is to implement an 8285 switch with a 3-slot 8272 ATM/LAN Switch Module right in the same wiring closet, as illustrated in Figure 30.

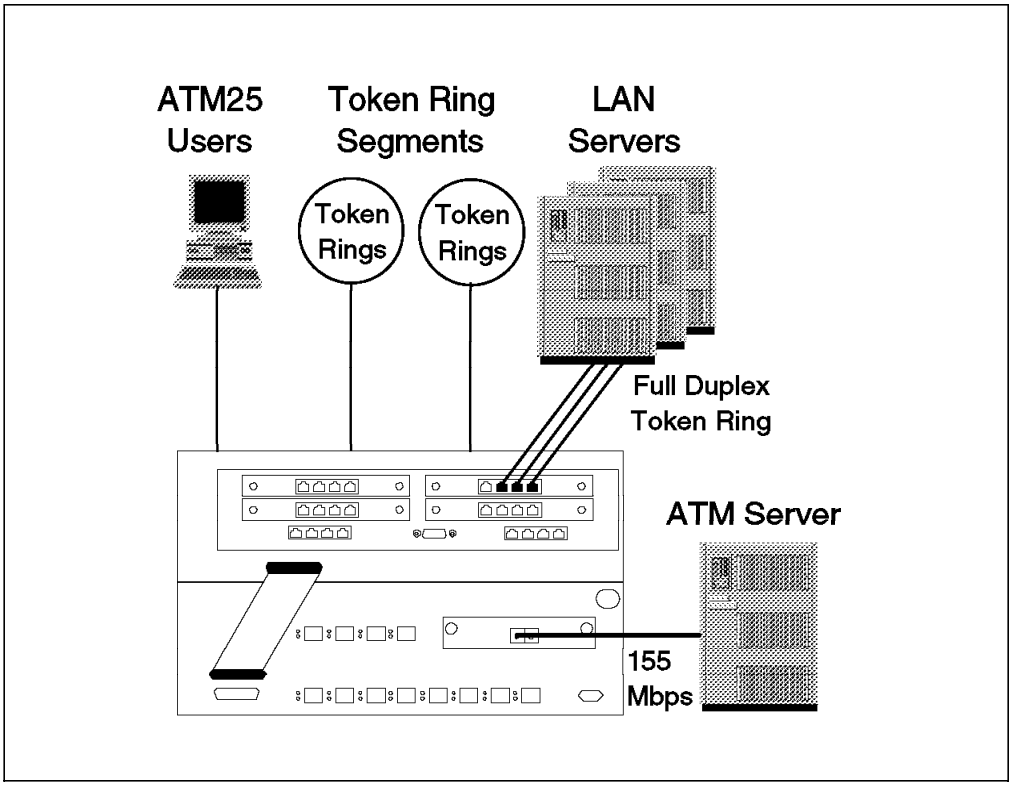

Figure 30. Relieving Token-Ring Congestion with LAN Switching Module

The first change to make is to move all four servers off of the common ring and give them dedicated bandwidth. If we use full-duplex token-ring adapters, such as the IBM Auto LANStreamer MC32 Adapter or the IBM Auto LANStreamer PCI Adapter, we can enable the servers for full-duplex operation, connect them to a LAN switch port, and let the LAN switch module automatically provide each server with 32 Mbps of dedicated bandwidth.

In addition, if we choose we can take advantage of the 8285 switch's 155 Mbps ATM port by installing a high-performance ATM adapter, such as the IBM Turboways 155 Mbps adapter, in our most heavily used server.

Next, we can use microsegmentation to reduce the number of workstations that have to share the token-ring's 16 Mbps of bandwidth. The segment size is limited only by the granularity of the token-ring concentrators you are using. If you are using a port-switching hub, such as the IBM 8260 Nways Multiprotocol Switching Hub, you can make your segments any size from two devices up to the architectural limit of the token-ring. And for those users who need the most performance that token-rings can provide, simply connect them directly to a port on the LAN switch module. This will provide them with up to 32 Mbps of dedicated bandwidth. In this case, since we have already used up 3 of our 24 available token-ring ports for the servers, we can have as many as 21 segments switched by the LAN Switching module.

Finally, to further reduce the number of workstations sharing token-ring bandwidth, you can begin to move some of your power users directly to the ATM network by installing ATM25 adapter cards, such as the IBM Turboways 25 adapter, in their workstations, running the simple migration utility, and connecting them to an ATM 25 Mbps port on the IBM 8285 Base Unit. They now have dedicated bandwidth of 25 Mbps to their desktop and access to all of the resources of the ATM network, while still retaining access to the shared media resources, such as the full-duplex token-ring servers. We do that with 12 of our workstations, reducing the number of workstations on shared token ring segments to 68.

Table 10 illustrates the before and after effects of our changes on the available bandwidth.

Table 10. Bandwidth Improvement with Token-Ring LAN Switch Module

Device	**Maximum Bandwidth Available After...(Kbps)**				**Bandwidth Improvement Ratio 2**
	Server Offload	**ATM Server**	**Micro-segment-ation 1**	**ATM25 Offload**	
Primary Server	32000	155000	155000	155000	811x
Secondary Server	32000	32000	32000	32000	167x
Token-Ring Desktop	200	200	4000	4942 3	25x
ATM Desktop	200	200	4000	25000	130x

Note:

1 In this case assuming an even distribution of four workstations per segment on each of 21 available token-ring segments.

2 Calculated by dividing the total bandwidth available after the change by the original bandwidth available per device, which was calculated by dividing the total bandwidth available by the number of devices sharing it. In this case, the original bandwidth calculation is: 16,000 Kbps/segment * 1 segment / (80 users + 4 servers) = 191 Kbps/device.

3. This is an average value. The 12 segments with three devices/segment would actually receive 5,333 Kbps while the remaining nine segments would have four devices apiece, each receiving 4,000 Kbps.

Using a similar analysis, we can see in Table 11 on page 79, the bandwidth improvement possible for a constrained Ethernet environment of 40 users and 4 servers. In this scenario, we have added an 8285 switch with an 3-slot 8271 ATM/LAN Switch Module as shown in Figure 31 on page 79. In this case, however, rather than move our secondary servers to full-duplex Ethernet, we will go directly to 100base-Tx, providing each secondary server with 100 Mbps of dedicated bandwidth.

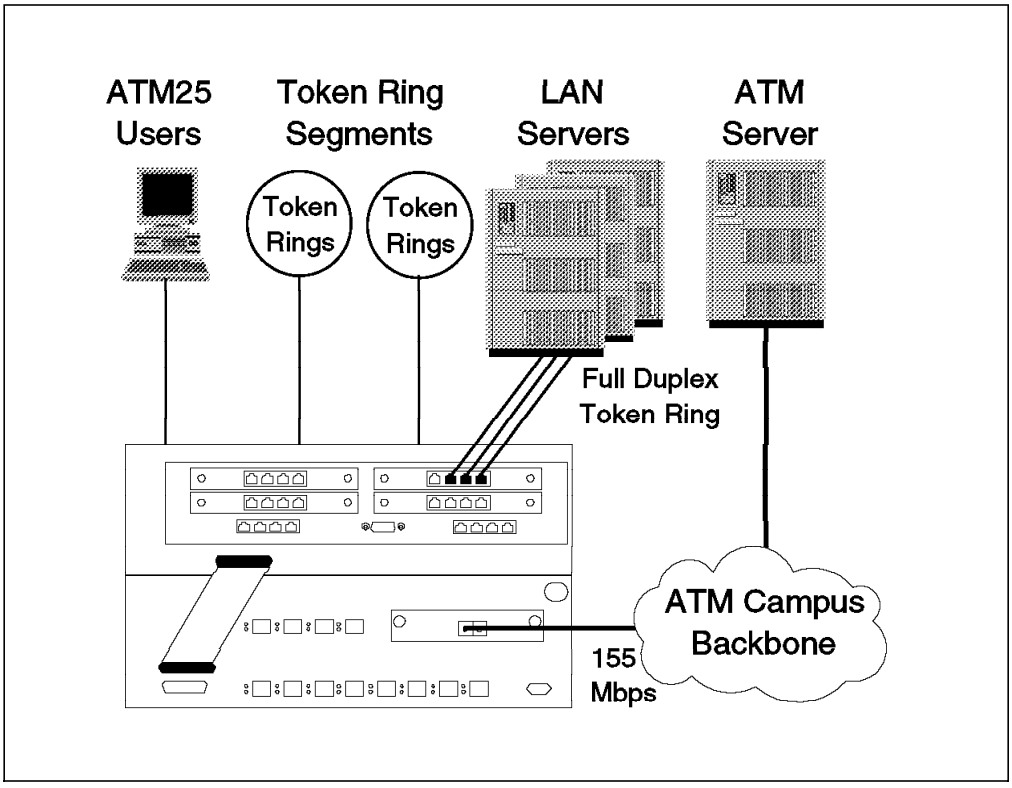

Figure 31. Relieving Ethernet Congestion with LAN Switching Module

Note

The choice of 100Base-Tx in this scenario is merely to demonstrate the versatility of the LAN Switch modules in conjunction with the 8285 switch. For the purposes of the example, we could have just as easily moved all of the servers to ATM directly, providing 155 Mbps to each server. Or we could have connected a shared 100Base-Tx segment to the LAN switch module to access resources on that segment and to provide ATM access to the 100Base-Tx users.

Table 11 illustrates the before and after results of our changes.

Table 11 (Page 1 of 2). Bandwidth Improvement with Ethernet LAN Switch Module

Device	Maximum Bandwidth Available (Kbps)				Bandwidth Improvement Ratio 2
	Server Offload	ATM Server	Micro-segment-ation 1	ATM25 Offload	
Primary Server	100000	155000	155000	155000	682x
Secondary Server	100000	100000	100000	100000	440x

Table 11 (Page 2 of 2). Bandwidth Improvement with Ethernet LAN Switch Module

Device	Maximum Bandwidth Available (Kbps)				Bandwidth Improvement Ratio [2]
	Server Offload	ATM Server	Micro-segment-ation [1]	ATM25 Offload	
Ethernet Desktop	250	250	4000	5714 [3]	25x
ATM Desktop	250	250	4000	25000	110x

Note:

[1] In this case assuming an even distribution of three workstations per segment on each of 16 available Ethernet segments.

[2] Calculated by dividing the total bandwidth available after the change by the original bandwidth available per device, which was calculated by dividing the total bandwidth available by the number of devices sharing it. In this case, the original bandwidth calculation is: 10,000 Kbps/segment * 1 segment / (40 users + 4 servers) = 227 Kbps/device. To be fair, this is a nominal value: in reality, the available bandwidth on a shared Ethernet segment rarely exceeds 40-50% of the rated bandwidth because of collisions and re-transmissions.

[3] This is an average value. The four segments with one device would actually receive 10,000 Kbps/device, while the remaining 12 segments would have two devices a piece, each receiving 5,000 Kbps.

Chapter 5. 8285 ATM Network Specifications

This chapter gives ATM connections and Traffic management specifications supported by the 8285.

5.1 ATM Connections

The IBM 8285 provides support for the following types of connections:

- Permanent Virtual Connection (PVC)

  Two types of PVCs are supported:

  – PVC for virtual channel connections (VCC)

  – PVC for virtual path connection (VPC), also known as permanent virtual path (PVP)

- Permanent Virtual Path (PVP)

  Note that PVPs are not supported when they span over NNI links. However, PVPs are supported over SSI links.

- Switched Virtual Connection (SVC)

Note: Switched virtual path (SVP) is not supported by the IBM 8285.

5.1.1 Supported VPI and VCI Range

The virtual path identifiers (VPIs) and virtual channel identifiers (VCIs) supported by the 8285 are depending the control point version.

Version 1.3:

For the 25 Mbps port:

- VPIs are in the range 0-3.
- VCIs are in the range of 32-1023.

For the other ports:

- VPIs are in the range 0-15.
- VCIs are in the range of 32-1023.

Note that certain workstation adapters have limited addressing capability as far as the supported VPIs and VCIs are concerned. These limitations are based on the number of bits in the ATM header that are recognizable by the workstation adapter and are defined in the ILMI packets exchanged by the adapter. The 8285 dynamically adjusts the supported VPI and VCI range on a port to the capability of the attached workstation at the ILMI exchange.

Version 1.4:

For the 25 Mbps ports:

One of the following three modes (ranges) can be selected:

- VPI/VCI: 0 bit/12 bits (VPI=0, VCI=0 through 4095)
- VPI/VCI: 2 bits/10 bits (VPI=0 through 3, VCI=0 through 1023)
- VPI/VCI: 4 bits/8 bits (VPI=0 through 15, VCI=0 through 2556)

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For the other ports:

One of the following three modes (ranges) can be selected:

- VPI/VCI: 0 bit/14 bits (VPI=0, VCI=0 through 16383)
- VPI/VCI: 4 bits/10 bits (VPI=0 through 15, VCI=0 through 1023)
- VPI/VCI: 6 bits/8 bits (VPI=0 through 63, VCI=0 through 256)

For more details refer to 3.3.4, “Control Point V1.4” on page 31.

5.1.2 Supported Virtual Connection Types

Table 12 shows the type of virtual connections supported by the IBM 8285.

Table 12. Supported Connection Type by the A-CPSW Module

Connection Type	Supported?
Unidirectional point-to-point	No
Bidirectional point-to-point with symmetric bandwidth	Yes
Bidirectional point-to-point with asymmetric bandwidth	No 1
Unidirectional point-to-multipoint	Yes
Bidirectional point-to-multipoint	No
multipoint-to-multipoint	No

1 If a call setup request with asymmetrical bandwidth requirement is received, the 8285 will establish the call with the higher peak rate used for both directions.

5.1.3 Maximum Number of Connections Supported

The maximum number of supported connections depends on their type (point-to-point or point-to-multipoint) and for point-to-multipoint connections on the number of parties per connection. The following are the rules you can use to determine the number of connections supported in your environment:

- The IBM 8285 has 4,096 connection control blocks.
- Each point-to-point connection requires two control blocks.
- Each party on a point-to-multipoint connection requires one connection control block.
- The maximum number of point-to-point connections supported by an IBM 8285 with its expansion is 2,048 regardless the expansion unit installation.
- The maximum number of point-to-multipoint trees supported is 127.
- The maximum number of parties supported for all the point-to-multipoint trees is 1024.
- The maximum number of PVCs is 100.
- The maximum number of point-to-point connection per media modules or base unit is 2048 with Version 1.4 (was 992).
- The maximum number of parties for point-to-multipoint connections for the base unit or per media module is 1024.
- The maximum number of point-to-point connection per 8285 port is 2048.

- The maximum number of VPI connections supported per 25 Mbps port is 16 and 64 for the others.

5.1.4 How PVCs Are Supported

To support PVCs, the 8285 maps them internally onto SVCs. This allows the PVC to be automatically reestablished using an alternate path in case of a link or node failure on the original path supporting the PVC. In addition, the parameters specified for the setting of the PVCs are saved in the NVRAM of the 8285 to provide automatic reestablishment of the PVC after the 8285 power off or reset condition.

Note that the information about PVCs is only stored in NVRAM after the connection is activated. This is to ensure that only the current and valid PVCs are restarted.

When an 8285 is restarted and an SVC is to be established before all the PVCs have been reestablished, a problem could occur if that SVC is allocated a label that is owned by one of the PVCs. To overcome this problem, the 8285 always checks to see if a label is not reserved by a PVC before allocating it to an SVC.

5.1.5 How to Configure PVCs

PVCs can be set up using the command line interface or the Nways Campus manager program. The following example shows how to configure a PVC for the configuration shown in Figure 32.

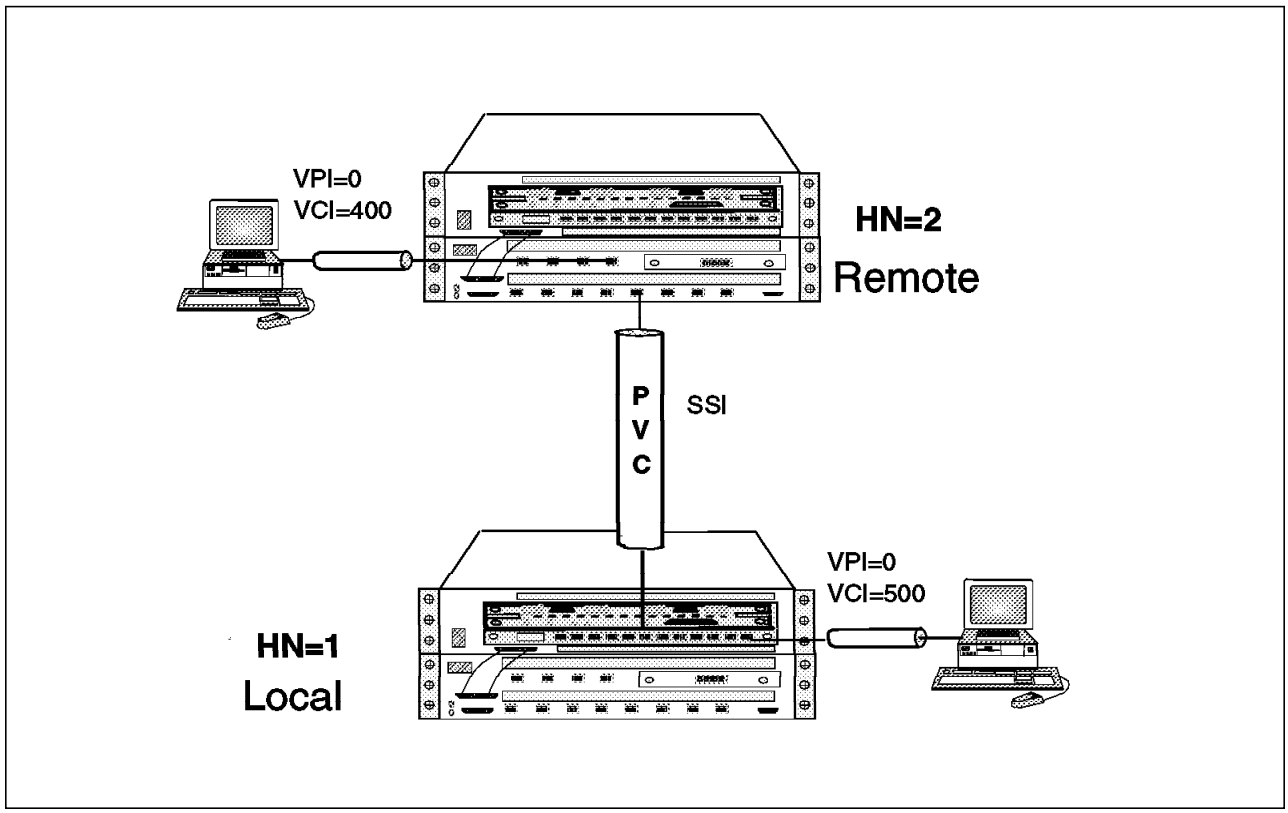

Figure 32. Sample PVC Configuration

```
8285A>set pvc 2.1 100 1.9 2 channel 0.500 0400 best_effort
```

Note that in this example, we have chosen the following attributes for the PVC:

- Workstation attached on the local 8285: slot.port 2.1.
- Workstation attached on the remote 8285: slot.port 1.9.
- PVC_id = 100.

  This is an arbitrary number that you can use to identify the PVC on various displays.
- Remote hub identifier = 2.

  This identifies the hub number (HN) of the remote hub (the hub on which the PVC terminates) within the cluster.
- VPI/VCI on the local hub:
  - VPI = 1
  - VCI = 500
- VPI/VCI on the remote hub:
  - VPI = 0
  - VCI = 400
- PVC type = best_effort.

The VPI/VCI values chosen for each port must be free at the time of defining the PVC. You can find out the VPI/VCI values that are currently allocated to the other connections on the port by using the Nways Campus manager ATM for AIX. If you are not sure which VPI/VCI is available for allocation, you may use the following command, which will allow the 8285 Control-Point available VPI/VCI pair that is assigned for the PVC on each port:

```
8285A>set pvc 2.1 100 1.9 2 channel * * best_effort
```

You can display the configuration information about a specific PVC or all the PVCs using the SHOW PVC command. The following example shows the output that will be displayed as a result of this command:

```
8285A> set pvc 2.1 100 1.9 2 channel 0.400 0.500 best_effort
PVC set and started.
8285A> show pvc all

       Local endpoint         | Remote endpoint   |
------------------------------|-------------------|
 Port   id   type   Vpi/Vci   | Port Vpi/Vci   HNb|   role   |QOS| Status
------------------------------|-------------------|----------|---|--------
2.01    100 PTP-PVC   0/500   |1.09    0/400     2| Primary  | BE|Active
1.09   1001 PTP-PVC   0/400   |2.01    0/500     1|Secondary | BE|Active
8285A>
```

You may display additional information about the configuration of the PVC by using the verbose parameter in the SHOW PVC command as shown in the following example:

```
8285A> show pvc 2.1 100 verbose

       Local endpoint          | Remote endpoint    |
-----------------------------|--------------------|
 Port   id   type   Vpi/Vci   | Port Vpi/Vci   HNb|    role   |QOS| Status
-----------------------------|--------------------|---------|---|--------
2.01    100 PTP-PVC   0/500  |1.09    0/400     2| Primary | BE|Active
Remote address : 39.09.85.11.11.11.11.11.11.11.11.01.02
Quality of Service : Best Effort.
Last Active Date : 16:38:55 2 Nov 96 (0 failures)
8285A>
```

5.1.6 How PVPs Are Supported

PVPs are supported through the PVCs.

5.1.7 How to Define PVPs

PVPs can be set up using the command line interface or the Nways Campus manager program. The following example shows how to configure a PVC for the configuration shown in Figure 33 on page 86.

```
8285A>set pvc 2.7 100 1.9 2 path 14 15 best_effort
```

Note that in this example the following attributes are defined for PVP:

- Slot.port on the local 8285 = 2.7.
- Slot.port on the remote 8285 = 1.9.
- PVP_id = 100.

  This is an arbitrary number that you can use to identify the PVP on various displays.
- Remote hub identifier = 2.

  This identifies the hub number (HN) of the remote hub (the hub on which the PVP terminates) within the cluster.
- VPI on the local hub = 14.
- VPI on the remote hub = 15.
- PVP type = best_effort.

The VPI values chosen for each port must be free at the time of defining the PVP. You can find out the VPI values that are currently allocated to the other connection on the ports by using the Nways Campus manager ATM for AIX. If you are not sure which VPI is available for allocation, you may use the following command which will allow the 8285 Control-Point to select the VPI value that is assigned for the PVP on each port:

```
8285A>set pvc 2.7 100 1.9 2 path * * best_effort
```

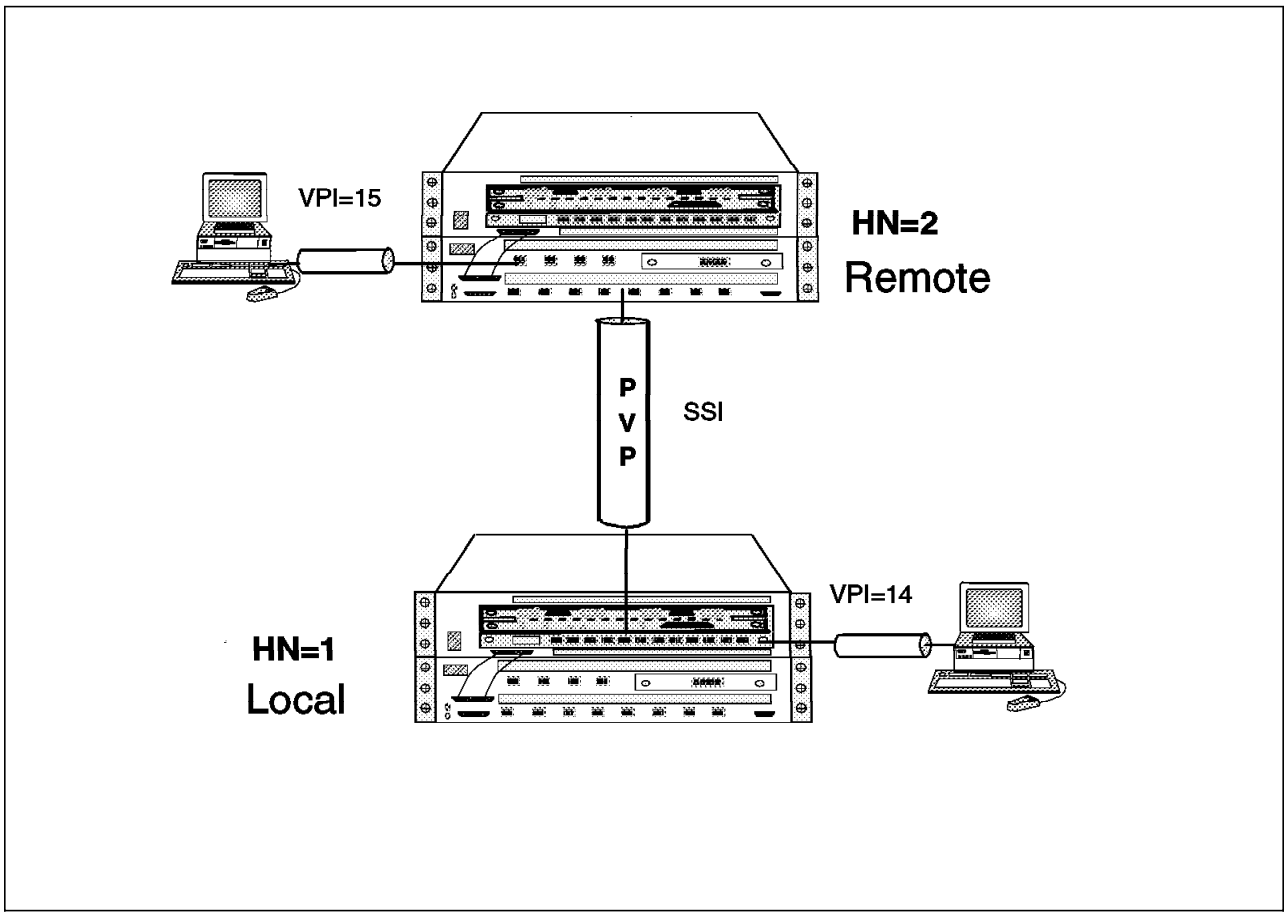

Figure 33. Sample PVP Configuration

You display configuration information about PVPs using the SHOW PVC command, as described in 5.1.5, “How to Configure PVCs” on page 83.

The following is an example of the output display for a PVP.

```
8285A> set pvc 2.7 100 1.9 2 path 14 15 best_effort
PVC set and started.
8285A> show pvc all

       Local endpoint          | Remote endpoint   |
-------------------------------|-------------------|
 Port   id   type   Vpi/Vci    | Port Vpi/Vci   HNb|    role   |QOS| Status
-------------------------------|-------------------|-----------|---|---------
2.07    100 PTP-PVP  14/*      | 1.09  15/*       2| Primary   | BE|Active
8285A>
```

5.1.8 How a VPI/VCI Is Allocated to SVCs

For virtual connections (both SVCs and PVCs), the VPI/VCI allocation is performed on a per-port basis.

For an SVC, it’s always the 8285’s role to allocate any VPI/VCI used by the SVC at each segment of the connection. The procedure for allocating a VPI/VCI for the SVCs is based on the following considerations:

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- The VPI value is always 0 on the UNI and SSI links. On the NNI links, the VPI value is as defined in the SET LOGICAL_LINK command for that NNI link.
- The VCI values 0 through 31 are always reserved for ITU and ATM Forum.
- The 127 odd-numbered VCIs between 32 and 286 (that is VCI 33, 35, 37, etc., through 285) are reserved for point-to-multipoint connections.
- The even-numbered VCIs between 32 and 286 (32, 34, 36, etc., through 286) and all the VCIs from 287 up to and including 1023 can be used by the SVCs.
- The VPI/VCI allocation algorithm is to increment the highest previously allocated VCI value and verify that this value is not in use by a VC or a VP connection. When incrementing the VCI value, the following considerations apply:
  - If the connection is a point-to-point connection and the currently highest allocated VCI is less than 286, the VCI value is incremented by two.
  - If the connection is a point-to-point connection and the currently highest allocated VCI is 286 or higher, the VCI value is incremented by one.
  - If the connection is a point-to-multipoint connection, the VCI value is incremented by one.
  - If the currently allocated VCI value for the point-to-point connections is 1023, the next VCI allocated will be the first free VCI value starting from 32.
  - If the currently allocated VCI value for the point-to-multipoint connections is 285, the next VCI allocated will be the first free VCI value starting from 33.

For PVCs, as described in 5.1.5, “How to Configure PVCs” on page 83, you can either specify the VPI/VCI values allocated to the PVC at the two ports, which are the endpoints of the PVC, or you may leave it to the 8285 to select the VPI/VCIs which are allocated. If you choose the latter, the 8285 will use the algorithm described for SVCs to allocate the VPI/VCI values. For the intermediate links on a PVC, it is always up to the 8285 to allocate the VPI/VCI values using the previous algorithm.

For PVPs, as described in 5.1.7, “How to Define PVPs” on page 85, you can either specify the VPI value allocated to the PVP at the two ports, which are the endpoints of the PVP or you may leave it to the 8285 to select the VPI/VCIs which are allocated. If you choose the latter, the 8285 will increment the highest previously allocated VPI and check to see if this value is not already in use. When the VPI value reaches the upper bound of VPI (15), the next VPI value wraps to 0. For intermediate links on a PVP, it is always up to the 8285 to allocate the VPI values using the previous algorithm.

5.1.9 How Point-to-Multipoint Connections Are Supported

To support point-to-multipoint connections, one cell destined for multiple ports occupies only one cell location in the shared switch memory. However, multiple output queues (one per media module) point to that one cell location. When the multicast cell arrives at the top of the output queue, it is sent to the output module. Within the output module, if the point-to-multipoint connection spans over multiple ports, then the multicast cell is replicated as required. The switch keeps track of when the last output port has transmitted the cell, thereby allowing its memory locations to be freed. This technique minimizes the amount of memory space required for multicast messages.

5.1.10 8285 LAN Emulation Specifications

The 8285 is able alone to manage small LAN emulation networks.

Mechanisms and characteristics supported are:

5.1.10.1 LAN Emulation Server (LES) and Broadcast Unknown Server (BUS)

- Number of LES: 2
- Maximum number of client registrations per LES: 128
- Maximum number of client registration for both LES: 128
- Multicast trees used by LES and BUS
- Each LES is using one control distribute VCC for the non-proxy LECs, and one control distribute VCC for the proxy LECs
- Each BUS uses one multicast forward VCC for proxy and non-proxy LECs.

5.1.10.2 IP over ATM (RFC 1577)

- In-band management for SNMP/Telnet/Ping supported.
  - Maximum transmission unit (MTU) size supported: 944 bytes.
- IP over ATM client imbedded.
  - Maximum concurrent IP over ATM connections supported: 64.

5.1.10.3 LAN Emulation Client (ATM Forum-Compliant LAN Emulation)

- Number of LECs: 2.
  - Token-Ring LAN (802.5).
  - Ethernet LAN (Ethernet 802.3 or Ethernet V2/DIX).
  - Both LEC can run concurrently.
- Maximum number of connections supported per LEC: 30
- Maximum length of LANE information field (MTU):

  Is depending on the the maximum service data unit (SDU) size supported on the corresponding ELAN.

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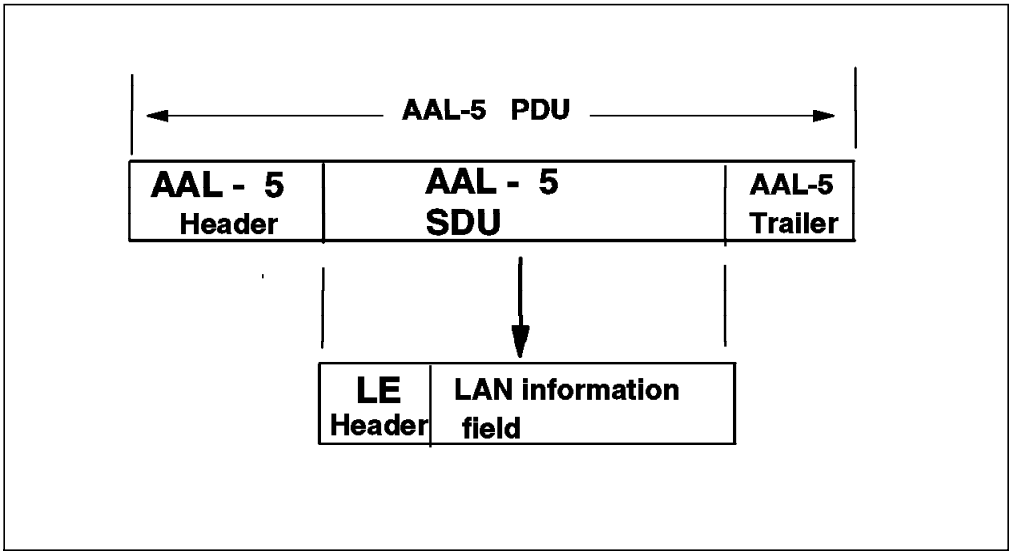

Figure 34. LAN Information Frame Location

Table 13. LANE Information Field Lengths

SDU SIZE	Maximum Length 802.3 LEC	Maximum Length DIX LEC	Maximum Length 802.5 LEC
1516	1492	1500	1462
4544	4520	4528	4490
9234	9210	9218	9180
18190	18166	18176	18136

5.2 Traffic Management

The following sections provide background information about traffic management in ATM networks and how it is implemented in the 8285.

Table 14 summarizes the characteristics of various traffic types.

Table 14. Types of Traffic

	CBR	VBR	UBR	ABR
Connection Mode	Connection-oriented	Connection-oriented	Connection-oriented	Connection-oriented
Timing Sensitive	Yes	Yes	No	No
ATM Adaptation Layer	AAL 1	AAL 2	AAL 3/4, 5	AAL 5
Quality of Service	Yes	Yes	No	Yes
Reserved Bandwidth	Yes	Yes	No	No
Flow Control	No	No	No	Yes
Traffic Types	Voice, Video	Compressed Voice, Video	Data	Data

5.2.1 Service Classes Supported by the IBM 8285 ATM Workgroup

The following quality of service (QoS) classes are supported by the 8285 control point:

- Constant bit rate (CBR)
- Variable bit rate - real time (VBR-rt)

  This class is supported as CBR.
- Variable bit rate - non-real time (VBR-nrt)

  This class is supported as CBR.
- Unspecified bit rate (UBR)
- Available bit rate (ABR)

Table 15 provide information about the traffic management functions supported by the 8285.

Table 15. Traffic Management Functions Support

Traffic Management Functions	**Supported**
Connection admission control (CAC)	Yes
Usage parameter control (UPC)	No
Generic cell rate algorithm (GRCA)	No
Explicit forward congestion indication (EFCI)	Yes
Full packet level discard	Yes
Network parameter control	No
Random early detection (RED)	No
Selective cell discarding	No
Dynanic discard control	No

Chapter 6. IBM 8285 Planning and Installing

This chapter contains the following sections describe the planning and installation of the 8285 switch:

- Physical Planning (Installation Considerations):
  - Environmental considerations
  - Mechanical considerations
  - Power considerations
  - Cabling considerations
  - Availability considerations
- Logical Planning (Network Design Considerations)
- Installation Considerations
- Microcode/Picocode Considerations:
  - Reasons for upgrading the microcode
  - How to acquire the latest microcode
  - How to update the microcode

6.1 Physical Planning

This section discusses the following installation considerations that might affect how and where you choose to install the 8285 switch:

- Packaging
- Physical specifications

6.1.1 Packaging

The 8285 switch shipping group provides everything necessary to install and configure the 8285 switch, including the following items.

6.1.1.1 Base Unit

The base unit shipping group contains:

- An IBM 8285 Base Unit with mounting brackets attached
- A cable management bracket
- An RS-232 wrap plug
- An RJ45 wrap plug
- RS-232 connectors for connecting an ASCII console, consisting of:
  - An RS-232 straight cable
  - A null-modem interposer
  - A gender changer (25-pin D-shell Female/Female)
- A power cord suitable for the country
- The following publications:

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- *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381
- *IBM 8285 Nways ATM Workgroup Switch: Safety and Service Catalog*, SA33-0398
- *IBM 8285/8260: ATM Command Reference Guide*, SA33-0385

6.1.1.2 Expansion Unit

The expansion unit shipping group contains:

- An IBM 8285 Expansion Chassis with mounting brackets attached
- A cable management bracket
- A power cord suitable for the country
- An expansion interface cable
- An expansion connector wrap plug

6.1.1.3 Optional Items

Optional items include the following:

- A 155 Mbps ATM I/O Card (MMF)
- A 155 Mbps ATM I/O Card (SMF)
- IBM 8260/8285 ATM Module(s)
- Lobe Adapter Cables
  - IBM ATM RJ-45 STP Adapter Cable (part number 42H0544)
  - RJ-45 UTP Converter Cable (part number 10H3904)

Note

All data cables, including converter cables and crossover cables, must be ordered separately.

6.1.2 Physical Specifications

The following sections describe the physical specifications of the IBM 8285.

6.1.2.1 Environmental Specifications

The 8285 switch does not require any special cooling. However, care should be taken to ensure that its environment corresponds to the specifications listed in Table 16.

Table 16 (Page 1 of 2). Environmental Specifications of the IBM 8285 Nways ATM Workgroup Switch

Description	IBM 8285 Base Unit	Base plus Expansion
Operating Temperature	10•C to 40•C (50•F to 122•F)	10•C to 40•C (50•F to 122•F)
Storage Temperature	1•C to 60•C (33.8•F to 140•F)	1•C to 60•C (33.8•F to 140•F)
Operating Humidity	8% to 95% (non-condensing)	8% to 95% (non-condensing)
Air Exhaust	1.4m•/min	2.8m•/min

Table 16 (Page 2 of 2). Environmental Specifications of the IBM 8285 Nways ATM Workgroup Switch		
Description	**IBM 8285 Base Unit**	**Base plus Expansion**
Acoustic	5.8Bel	6.0Bel (with Expansion)

6.1.2.2 Mechanical Specifications

The 8285 switch is designed to be either rack-mounted or to rest on a table-top. Your mount must be able to support at least the following specifications, listed in Table 17, with the appropriate safety factors.

Table 17. Mechanical Specifications of the IBM 8285 Nways ATM Workgroup Switch		
Description	**IBM 8285 Base Unit**	**Base plus Expansion**
Width	440 mm (17.3 inches)	440 mm (17.3 inches)
Depth	508 mm (20.0 inches)	508 mm (20.0 inches)
Height	133.3 mm (5.25 in. or 3U)	133.3 mm (5.25 in. or 3U)
Weight (empty) Weight (fully loaded)	12.8 kg (28.2 lbs)	12.8 kg (28.2 lbs) 19.4 kg (36.8 lbs)
Mounting Clearances Front: Back:	 100 mm (4 inches) 300 mm (12 inches)	 100 mm (4 inches) 300 mm (12 inches)

6.1.2.3 Power Supply

The IBM 8285 Base Unit has a universal power supply, as does the 8285 Expansion Chassis. The power supplies are currently identical although this can be expected to change in the future.

- **General Power Specifications**

  Table 18 shows the general power specifications of the IBM 8285 Base Unit and the 8285 Expansion Chassis.

Table 18. Power Supply Specifications of the 8285		
Description	**Base Unit**	**Expansion Unit**
Current Draw - at 100V - at 240V	 3.6A 1.9A	 3.6A 1.9A
Surge Current	40A	40A
Leakage Current	2.7mA	2.7mA
Caloric Value - Kcal/hr - BTU	 44 174.59	 44 174.59

  Table 19 shows the anticipated power specifications of future models of the IBM 8285 Base Unit and the 8285 Expansion Chassis.

Table 19 (Page 1 of 2). Power Supply Specifications of Future 8285 Models		
Description	**Base Unit**	**Expansion Unit**
Current Draw - at 100V - at 240V	 2A 0.85A	 3A 1.25A

Table 19 (Page 2 of 2). Power Supply Specifications of Future 8285 Models		
Description	**Base Unit**	**Expansion Unit**
Surge Current	40A	40A
Leakage Current	3.5mA	3.5mA
Caloric Value - Kcal/hr - BTU	 72 285	 104 412.67

- **Power Budget for the Expansion Chassis**

  The 8285 Expansion Chassis has a universal power supply that provides power for these three available slots for 8285/8260 modules. When planning for your installation, please make sure that the power requirements of your planned configuration do not exceed either the +5V power budget or the +12V power budget.

  Note

  Any 8260 ATM module (except the A-CPSW module) will function properly in the 8285 Expansion Chassis provided that the power budget is not exceeded. However, any configuration containing modules that are not officially supported by the 8285 will be considered an unsupported configuration. Please note that as of November, 1996, the following 8260 ATM modules were not supported in the 8285:

  - 2-slot 8272 ATM/LAN Switch Module
  - 3-slot 8272 ATM/LAN Switch Module
  - 2-slot 8271 ATM/LAN Switch Module
  - 3-slot 8271 ATM/LAN Switch Module
  - Multiprotocol Switch Service (MSS) Server Module

  To determine if there is adequate power to support your desired configuration, simply add up the required power listed in Table 20, and make sure that it is less than the available power listed in the same table.

  Note: Although listed, there is no supported configuration in which the +12V power budget can be exceeded.

Table 20 (Page 1 of 2). Power Budget of the 8285 Expansion Chassis		
Device	**Watts (+5V)**	**Watts (+12V)**
Available Power Budget (Present/Future)	120/150	15.6/24
Required Power:		
ATM 2-Port 155 Mbps Flexible Media Module	25.0	1.2
ATM 3-Port 155 Mbps LAN Concentration Module	25.0	1.2
ATM 155Mbps I/O Cards: MMF,SMF,UTP/STP,STP	2.5	
ATM 4-Port 100 Mbps MIC Fiber Module	35.0	2.5
ATM 4-Port 100 Mbps SC Fiber Module	35.0	2.5
Video Distribution Module	37.5	
ATM 12-Port 25 Mbps UTP Concentrator Module	35.0	1.2
ATM 1-slot Carrier Module	17.5	0

Table 20 (Page 2 of 2). Power Budget of the 8285 Expansion Chassis

Device		Watts (+5V)	Watts (+12V)
ATM 2-Slot Carrier Module		17.5	
ATM 4-Port TR/Ethernet Bridge Module		82.0	12.0
ATM WAN Module		18.4	
ATM WAN I/O Cards: E3,DS3,OC-3,STM-1		7.9	
IBM Multiprotocol Switched Services Server		42.0	1.0
2-slot 8272 ATM/LAN Switch Module		67.5	
3-slot 8272 ATM/LAN Switch Module		67.5	
Token-Ring UFCs	4-Port UTP/STP	11.0	
	2-Port Fiber	8.0	
	1-Port ATM155	25.0	
	1-Port RMON	24.0	
2-slot 8271 ATM/LAN Switch Module		58.5	
3-slot 8271 ATM/LAN Switch Module		58.5	
Ethernet UFCs	4-Port 10Base-T	5.5	
	3-Port 10Base-FL	6.7	
	1-Port 100Base-Tx	5.7	
	1-Port 100Base-Fx	6.0	
	1-Port ATM155	25.0	

6.1.3 ATM Ports and Cabling

With its expansion, the IBM 8285 offers several physical kind of port connections to handle twisted pair, fibers and coaxial lines. The physical specification of each type of port are as follows:

- UTP/FTP/STP Ports
  - Physical Interface: RJ-45
  - 25 Mbps Cabling Supported and Maximum Distances:

    UTP Category 3 100 meters (unshielded twisted pair)

    UTP Category 4 150 meters

    UTP Cat.5 (100 Ohms) 160 meters

    FTP (100/120 Ohms) 150 meters (foiled twisted pair)

    SFTP (150 Ohms) 150 meters (shielded and foiled twisted pair)

    STP (150 Ohms) 300 meters (shielded twisted pair)
  - 155 Mbps Cabling supported and Maximum Distances:

    UTP Cat.5 (100 Ohms) 100 meters

    FTP (100/120 Ohms) 100 meters (foiled twisted pair)

    SFTP (100/120 Ohms) 100 meters (shielded and foiled twisted pair)

    STP (150 Ohms) 100 meters (shielded twisted pair)

  The ports comply with the latest ATM Forum specifications concerning pinouts. Although, the ATM25 cable uses the same number of pins as both

token-ring and Ethernet, the pinouts are different and incompatible, as shown in Table 39 on page 179.

- Fiber Ports
  - Physical Interface:

    100 Mbps ports: SC or MIC

    155 Mbps ports: SC
  - Cabling Supported:
    - Multimode Fiber I/O Cards

      100 Mbps/155 Mbps ports:
      - 50/125 µm (micron) multimode fiber
      - 62.5/125 µm
    - Single Mode Fiber I/O Cards

      155Mbps ports:
      - Light Source: LASER at 1300+/-20nm
      - 9(±1)/125 µm (micron) single mode fiber

    It is not necessary for a single type of fiber to be used from one end of a connection to another. However, doing so will provide you with longer distances between devices and may simplify troubleshooting and cable management issues as well. Should you choose to use different types/diameters of fiber, use the tables in the appendices of *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381 to determine if the optical budget for each port is adequate.
- E3 COAXIAL BNC Ports:
  - Cable type: RG59
  - Impedance: 75 Ohms
  - Attenuation: 25dB MAX per 100m
  - Maximum distance: 100m
- D3 COAXIAL BNC Ports:
  - Cable type: RG59
  - Impedance: 75 Ohms
  - Attenuation: 25dB MAX per 100m
  - Maximum distance:

    68m by default

    135m using an option setting (see *IBM 8260/8285 ATM WAN Module Installation and User's Guide*, SA33-0396 at DS3 parameter "Line Buildout").

6.1.4 Planning for Availability

The 8285 switch is designated as a customer setup device. If you choose not to have the switch covered under an IBM maintenance plan, you may choose to provision one or more spares for key components to improve network availability. For your convenience, a cross-reference of components and part numbers is included in Table 42 on page 181.

6.2 Logical Planning

The following sections contain information about various aspects of IBM 8285 logical planning:

- Capacity planning:
  - Switching capacity
  - ATM bandwidth capacity
  - Integrated LES/BUS capacity
  - SSI connection (TRS capacity)
  - NNI connection
- Other Planning:
  - Compliance to the standards

6.2.1 Capacity Planning

The following sections describe several aspects of capacity planning for the 8285 switch, such as:

- Switching Capacity
- Bandwidth Capacity
- LES/BUS Capacity
- ATM Topology Management Limitations

Note that the values described in the following sections are theoretical maximums and may be different from the practical maximums that apply to your network.

6.2.1.1 Switching Capacity

- **Maximum Number of Connections**

  In most cases, the maximum number of connections per switch would be constrained by storage, such as the number of control blocks, rather than by the switch component capacity itself. Consequently, it may be possible to attain the maximum number of connections supported by the switch on an actual network if the traffic volume is not too much.

- **Transmit Delay (Latency per Port)**

  This value is sometimes used as a measure of the switch′s capacity. However, care should be used in using this value as a proxy for overall throughput in a real-world environment. It depends on several factors, some of which can be unrealistically tuned in a test environment to generate misleading results. It is especially affected by the utilization of those components that cause the increase in service waiting time, buffer shortages, and so on.

The system switching capacity maximums are listed in Table 21 on page 98 below.

Table 21. Connection Capacity of IBM 8285 Nways ATM Workgroup Switch		
Maximum Bidirectional Connections [1]	IBM 8285 Base Unit -With ATM firmware upgrade kit -Without ATM firmware upgrade kit	 2,016 [2] 992
	ATM Module -With ATM firmware upgrade kit -Without ATM firmware upgrade kit	 2,016 [2] 992
	IBM 8285 (with Expansion Unit) -With ATM firmware upgrade kit -Without ATM firmware upgrade kit	 2,016 [3] 2,016
	PVCs per IBM 8285	100 [4]
Maximum Multipoint Parties per IBM 8285		1,024

Notes

[1] Maximum Bidirectional Connections

Defined here as the sum of point-to-point (PTP) and point-to-multipoint (PTM) connections

[2] The module (CAP/CAD) is capable of supporting up to 4,064 bidirectional connections but the number is restricted to 2016 due to the 8285 ATM Control Point's capacity (2048 PVC - 32 PVC reserved).

[3] Due to the IBM 8285 control point capacity. (The number is 6,000 on the IBM 8260 A-CPSW.)

[4] Sum of PtP and PtM, and also sum of PVP and PVC connections.

In the case of the 8285 switch, the transmit latency is dependent on whether the switching is done in the base unit, via CAP/CAD, or when it is installed in the IBM 8285 Expansion Chassis with its switch-on-a-chip. Table 22 shows the maximum latency for both switching modes under both normal and high utilization.

Table 22. Transmit Delay (Latency per Port)			
Switching Mode	**Utilization**	**ATM Port**	**Latency (in microseconds)**
CAP/CAD	normal	25 Mbps	57 µs
		155 Mbps	41 µs
	high	25 Mbps	61 µs
		155 Mbps	44 µs
switch-on-a-chip	normal		33 µs
	high		40 µs

6.2.1.2 ATM Bandwidth Capacity

The ATM bandwidth should be considered in a large network, especially for reserved bandwidth connections, such as the connections between switches. This section describes the ATM bandwidth capacity of the 8285 switch and its components:

- **Total Bandwidth**

  The total bandwidth available for each IBM 8285 Base Unit and ATM module in the expansion unit is 212 Mbps/FDX. This is because, although the switch-on-a-chip supports up to 256 Mbps for each module, the switch uses 64-byte cells internally to transport 53-byte ATM cells. Therefore, the maximum external throughput per module is 256 Mbps x 53/64 or 212 bytes.

- **Total Reserved Bandwidth**

  The total reserved bandwidth available for each IBM 8285 base unit and for each ATM module in the expansion unit is 85 percent of the total bandwidth available and is 180 Mbps when the total bandwidth is 212 Mbps. In addition, the maximum reserved bandwidth for an ATM port is 85 percent of the physical port speed. For example, it becomes 85 Mbps for a 100 Mbps port and 131 Mbps for a 155 Mbps port.

Table 23 shows the summary of the IBM 8285 ATM bandwidth capacity.

Table 23. Bandwidth Capacity of the IBM 8285 Nways ATM Workgroup Switch

Description	Value
Total bandwidth for all ports in the base unit	212 Mbps (256 Mbps x 53/64)
Total bandwidth per an ATM module in the expansion unit	212 Mbps
Total reserved bandwidth for All ports in the base unit	180 Mbps (212 Mbps x 85%)
Total reserved bandwidth per an ATM module in the expansion unit	180 Mbps
Maximum reserved bandwidth per an ATM port	85% of physical port speed

6.2.1.3 Integrated LES/BUS Capacity

The IBM 8285 can integrate the LES/BUS server functions in the control point. This section describes the capacity information when the function is configured:

- **Maximum Number of LES/BUS Instances**

  When the LAN Emulation protocol is used, each LES/BUS instance will define an Emulated LAN (ELAN). The IBM 8285 can configure two LES/BUSs instances, and therefore two ELANs. To interconnect these ELANs together requires an ATM router, such as the IBM Multiprotocol Switched Services Server.

- **Maximum Number of LECs**

  The number of LECs can impact LES performance, for example, during the initial registration process and during the MAC-to-ATM address mapping process.

Table 24 on page 100 shows the summary of the IBM 8285 integrated LES/BUS capacity.

Table 24. LES/BUS Capacity of the IBM 8285 Nways ATM Workgroup Switch

Description	**Value**
Maximum Number of LES/BUS Instances (or ELANs)	2 **1**
Maximum number of LECs	128 **2**
LEC Registration Capacity	27 LECs/sec **3**

Notes:

1. Any two combinations of token-ring (IEEE 802.5) and Ethernet / IEEE802.3 LAN Emulation.
2. Sum of the LECs when two sets of LES/BUS configured.
3. Average value based on the performance test.

6.2.1.4 SSI Connection (TRS Capacity)

The IBM 8285 implements a dynamic routing mechanism between ATM switches. This mechanism, called the *switch-to-switch interface (SSI)* protocol, was developed by IBM based on the ATM Forum PNNI Phase 1 specification, and is an IBM exclusive. SSI provides many benefits, such as reducing the workload of route definition, enabling link aggregation between switches, and enabling automatic route backup should the primary route fail. However, as with any dynamic routing protocol, the need to exchange information between nodes can consume bandwidth and processing resources. The IBM 8285 has the following capacity limitations for SSI connection:

- Maximum number of ATM switches per cluster
- Maximum number of ATM switch hops in a cluster

  Call setup and cell transmit time are proportional to the number of hops.
- Parallel / Multiple SSI link

  Parallel SSI links between two hubs are supported but the bandwidth cannot be shared. This means a data path between two switches is assigned to a specific SSI link even if you have parallel SSI links. But parallel SSI links increase the total bandwidth available between switches. There is no limit for the number of the parallel SSI links but excessive links provide little additional benefit.

  Multiple SSI links which provide alternate paths are supported. There is no limit to the number of multiple SSI links allowed as long as the network is designed within the restrictions of the maximum number of ATM switches and ATM switch hops in a cluster.

Table 25 shows the summary of the TRS capacity of the IBM 8285 and IBM 8260.

Table 25. TRS Capacity of the IBM 8285 Nways ATM Workgroup Switch and IBM 8260 Nways Multiprotocol Switching Hub

Description	Value
Maximum number of the ATM switches per a cluster	25
Maximum number of the ATM switch hops in a cluster	5

6.2.1.5 NNI Connection

The IBM 8285 implements static routing mechanism between ATM switches as well. It is called NNI and is fully-compliant with the IISP specification of The ATM Forum. The NNI connection may be established on a physical link (direct connection) or over a permanent VP (PVP) connection via the ATM WAN module. As of today, IISP is the only protocol that can be used to interconnect an IBM campus ATM switch to another vendor′s switch. On the NNI connection, the following capacity limitations should be considered:

- **Maximum number of static route definitions**

Each NNI connection requires that a static route be configured so that the routing mechanism is aware of the destination network. The maximum number of static route definitions is 50 per control point.

- **Maximum number of NNI links per port**

  The maximum number of NNI logical links per port is only restricted by the maximum number of VPCs since an NNI logical link needs a unique VPI value to distinguish it from the others. Therefore, the maximum number of NNI logical links per port is 15 on the 25 Mbps ports and 63 on the other ports.

  The maximum number of NNI logical liks per 8285 is 64.

Note

Prior to the control point code V1.0.1, static routes could not be defined to nonadjacent clusters. This limitation has been removed.

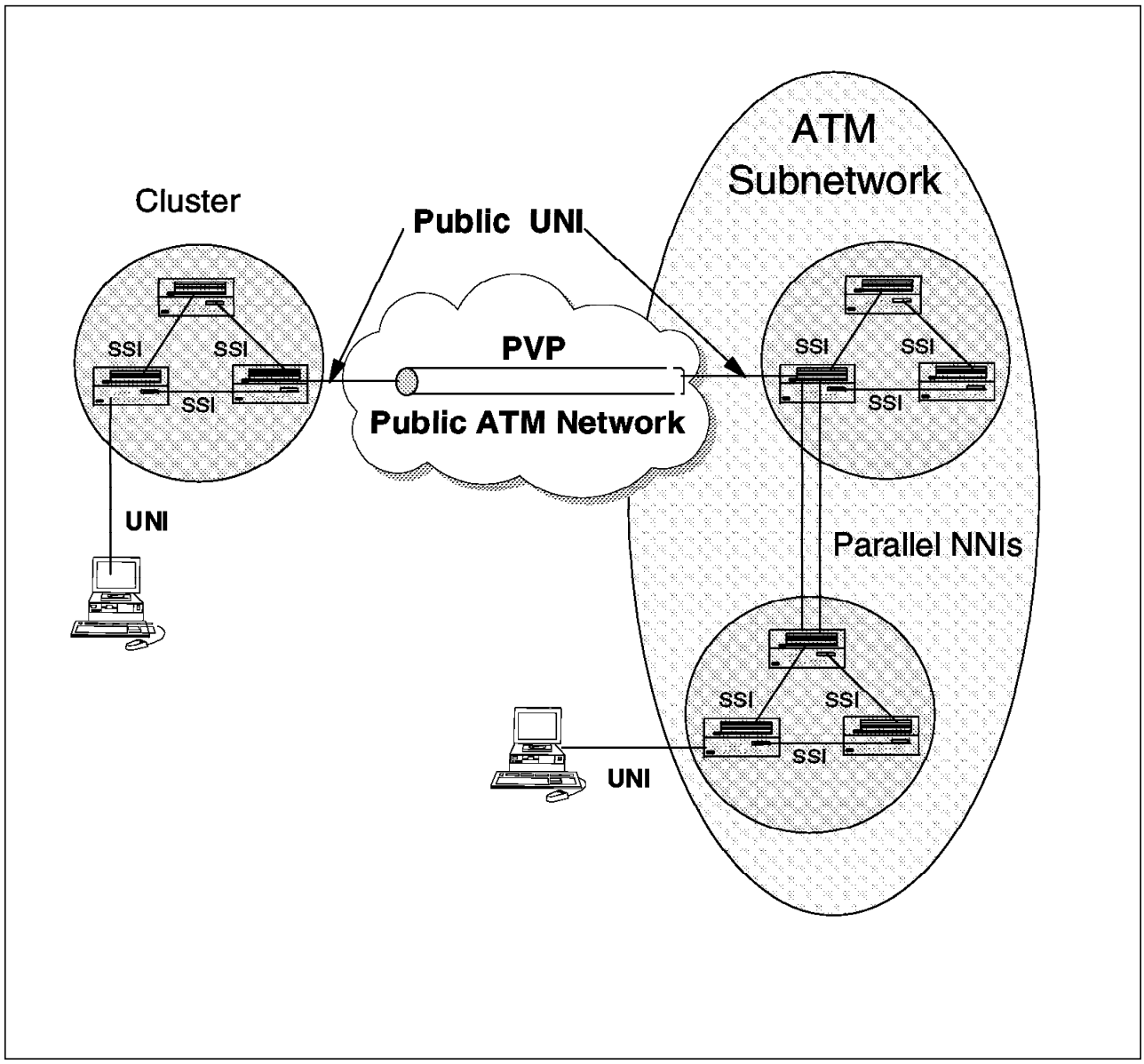

Figure 35. Complex ATM Network Using ATM 8285

Figure 35 shows an ATM network mixing private and public environments. Grouping ATM switches into separate clusters limits your network restart time, limits the number of topology updates sent (as topology information remains within a cluster), and reduces the resources required on each node to maintain the network topology. ATM clusters in Figure 35 are interconnected in a bigger structure called a subnetwork to improve performances. Clusters are interconnected by parallel NNI connections increasing bandwidth (link aggregation) and offering redundancy.

6.2.2 Standards Compliances

The following section describes additional planning information about the IBM 8285 in accordance with the ATM standards.

6.2.2.1 Compliance to the Standards

The IBM 8285 is compliant to the following standard specifications:

- **Physical Interface**

  As to the physical interface, refer to section 6.1.3, “ATM Ports and Cabling” on page 95.

- **UNI (User-to-Network Interface)**

  There are three versions of UNI standardized by *The ATM Forum*, V3.0, V3.1, and V4.0. The IBM 8285 supports the following UNI versions:

  – V3.0

  – V3.1

  In addition, the 8285 switch supports the dynamic interconnection between UNI V3.0 and V3.1 devices as well. Both SVC and PVC are supported and they can be defined on the same physical port.

- **NNI (Network-to-Network Interface)**

  There are two protocols of NNI standardized by *The ATM Forum*, IISP (Interim Inter-switch Signaling Protocol) previously called PNNI Phase 0, and PNNI (private network-to-network interface) Phase 1. The IBM 8285 supports the following NNI protocols:

  – IISP

  The IISP protocol is called NNI in the IBM campus ATM Switch terminology.

- **LANE (LAN Emulation)**

  There are two versions of LANE standardized by The ATM Forum, V1.0 and V2.0. The IBM 8285 supports the following LANE version and components:

  – LANE V1.0 (both IEEE 802.5 and Ethernet/IEEE 802.3 LANE)

    - LES (LAN Emulation Server)
    - BUS (Broadcast and Unknown Server)
    - LEC (LAN Emulation Client) for node management

  The LES/BUS function can interwork with an external LECS. To get the LECS address, all of the standardized mechanisms (via ILMI, using the LECS well-known address (WKA), and the LECS PVC) are supported.

  Note

  The order an LEC attempts the mechanisms is also standardized by *The ATM Forum* and is as follows:

  1. Get LECS address via ILMI
  2. Use the LECS well-known address
  3. Use the LECS PVC

6.3 Install

The following sections describe information about the IBM 8285 installation:

- Physical Installation
- 8285 Console

6.3.1 Physical Installation

The physical installation procedure of the IBM 8285 is completely described in *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381. The physical planning information described in 6.1, "Physical Planning" on page 91 can help your installation as well.

Note

It is not described in the above manual but please make sure that the expansion unit is installed directly above the base unit. Otherwise, if it is installed below, the physical connection of the expansion unit cable may not be smooth and may also prevent you from connecting your local console.

6.3.2 8285 Console

When the physical installation procedure is completed, you have to make sure the system is operating properly, and start customizing the IBM 8285. Although some valuable information can be determined by observing the front panel LEDs, you really need to connect the 8285 console to check the detailed status and to start the customizing process.

The following sections describe the console setup procedure and the basic console functions required to check the status of the IBM 8285.

- Overview
- Setup Procedure
- Basic Console Functions

6.3.2.1 Overview

The configuration console supports both out-of-band and inband access. However, out-of-band access is required for the initial setup since some parameters, such as the IP address, need to be configured before the console can be reached via an inband connection.

The out-of-band console is connected to the console port on the base unit and the connection is supported by direct attachment or remote attachment via modem/telecommunication link. The out-of-band console supports two access modes: nrmal (ASCII) mode and SLIP mode.

The normal mode is very popular as a LAN device console interface. It uses a simple ASCII terminal interface normally and uses XMODEM file transfer protocol when downloading microcode. The SLIP mode uses a Telnet session normally and uses TFTP when downloading the microcode. Both TCP/IP protocols use SLIP as the protocol stack. The IBM 8281 and 8282 also use a SLIP interface as their configuration console interface but they use a native interface not a Telnet session.

The inband console is attached to the LAN and establishes a Telnet session to the IBM 8285 and uses TFTP to download microcode. Like the out-of-band SLIP mode, it uses the TCP/IP stack.

In addition to the configuration console, the 8285 switch can be managed via its SNMP interface, which allows most console functions to be performed via a user-friendly graphical interface. For more information about the SNMP management, refer to the following chapter.

6.3.2.2 Setup Procedure

This section describes the setup procedure summary for both normal and SLIP mode. The detailed procedure is described in the *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*, SA33-0381.

- **Normal Mode**

  The setup procedure of normal mode console is as follows:

  1. Connect an ASCII terminal

     Connect an ASCII terminal (pure ASCII terminal or PC/RISC workstation which has ASCII emulation function) to the IBM 8285. The connection can be directly, connecting the terminal to the console port on the front panel of the IBM 8285 base unit, or remotely via modems and a telecommunication link.

  2. Set up the console parameters

     Check if the console parameters settings of the terminal match the IBM 8285's, and change the values if needed. The factory-set default settings for the IBM 8285 are as follows:

Parameter	IBM 8285 Default Value
Baud rate	9,600
Data bits	8
Parity	None
Stop bits	1

  3. Access the IBM 8285

     When the previous procedure is completed, try to access the IBM 8285. The initial screen which requires your password input will appear after you press the Enter key. You may then enter 8285 which is the initial administrator password or just press Enter which is the initial user password.

     Note

     The password will not be visible.

     If you have changed the administrator password but forgotten it, refer to the procedure to reset the password to the factory default setting described in A.1.4, "Resetting the Password to Factory Default" on page 174.

     Note

     The passwords are case-sensitive although the commands are not.

After entering the proper administrator password, you will be logged in, and the 8285 will respond with a welcome message identifying what kind of access privileges (system administrator or user) you have. Figure 36 on page 107 shows the screen containing the initial prompt and the welcome message.

```
8285 Nways ATM Workgroup Switch
(C) Copyright IBM Corp. 1996. All rights reserved.

Password:

Welcome to system administrator service on 8285.
8285>
```

Figure 36. Logon Screen of the IBM 8285 Console

- **SLIP Mode**

  The setup procedure of SLIP mode console is as follows:

  1. Establish normal mode connection

     In order to have SLIP mode connection, some parameters are needed, such as an IP address. Then establish normal mode connection at first based on the procedure described in the setup procedure of Normal mode.

  2. Set up the console parameters

     You need to define local (IBM 8285) and remote (terminal) IP address for the SLIP protocol using the SET TERMINAL SLIP_ADDRESS command. And if you use a baud rate other than 9600bps, change the rate using the SET TERMINAL BAUD command.

  3. Change the operating mode

     The operating mode of the configuration console is either ASCII or SLIP mode and they are exclusive. You need to change the mode from normal to SLIP since the default setting is normal mode. You can change the mode using SET TERMINAL CONSOLE-PORT-PROTOCOL SLIP command.

     The console automatically returns to normal mode if no activity takes place for a period of 20 minutes or if the IBM 8285 resets.

  4. Access the IBM 8285

     When the previous procedure completed, try to access the IBM 8285. In SLIP mode, you need to start a Telnet session to the IBM 8285. The logon procedure is the same as for the normal mode.

6.3.2.3 Basic Console Functions

This section describes the basic console functions to check if the physical installation has been done successfully.

Te following commands are useful to check the IBM 8285 status:

- SHOW DEVICE
- SHOW MODULE

First, if you can access the IBM 8285 using the console interface, it means the IBM 8285 microcode works fine. The level and status of the IBM 8285 microcode can be checked using the SHOW DEVICE command. And the SHOW MODULE command can be used to check the FPGA picocode level and status of an ATM blade.

Figure 37 shows the console screen when the SHOW MODULE command is issued to check the physical installation status.

```
8285> show module all  1

Slot Install Connect Operation General Information
------------------------------------------------------------------------------
  1     Y       Y        Y     8285 Nways ATM Workgroup Switch  2
  2     Y       n        n     -  2
  3     n       n        n     -
  4     n       n        n     -
8285> set module 2 connected enable  3
Slot 2:Module set
8285> show module all  4

Slot Install Connect Operation General Information
------------------------------------------------------------------------------
  1     Y       Y        Y     8285 Nways ATM Workgroup Switch
  2     Y       Y        Y     8285 ATM Wan module with E3 + E3 Ports  5
  3     n       n        n     -
  4     n       n        n     -
8285>
```

Figure 37. Sample Screen to Check the Physical Installation

Notes

1 The SHOW MODULE command is issued to the IBM 8285 base unit that has an expansion unit with a WAN module connected to it.

2 All status indicators of the Base Unit (install, connect and operation) are Y (yes) but only the install status of module installed in the expansion unit is Y. This is normal.

If you don't have the expansion unit, only the first line, starting with slot number 1, is displayed.

3 To change the other status indicators, issue the SET MODULE command.

4 The SHOW MODULE command is issued after the SET MODULE command.

5 All of the status indicators of the module have become Y. This means the physical installation has been done successfully. If any status does not become Y, check the physical installation procedure.

Note

Most of the MES processes, such as installing or removing a module, do not prevent the others from working. However, the process of adding or removing the expansion unit to or from the IBM 8285 base unit makes the ATM subsystem reset.

The install status may be Y even if no module installed. This should be normal because the IBM 8285 does not clear the previous status. If you really want to clear the status, use the CLEAR CONFIGURATION command in maintenance mode.

6.3.3 ATM Concentration Module Basic Configuration Process Steps

The module configuration process is very straight-forward. It summarizes briefly what operations must be done to install ATM port concentration modules. However, you should familiarize yourself with the following reference materials before you begin:

Table 26 (Page 1 of 2). References and Process Quick Guide

Task	References
Physical Installation	• *8260/8285 ATM 25 Mbps Concentration Module: Installation and User's Guide*, SA33-0383 • *8260/8285 ATM 155 Mbps Flexible Media Module: Installation and User's Guide*, SA33-0358 • *IBM 8260/8285 A4-FB100 Module Installation and User's Guide*, SA33-0324 • *IBM 8260/8285 ATM WAN Module: Installation and User's Guide*, SA33-0396 • *8260/8285 Video Distribution Module: Installation and User's Guide*, GA27-4173 – Uncrating – Installing I/O Cards – Installing Module – Connecting Cables
Configuration Process	• *IBM 8260/8285 ATM Command Reference Guide*, SA33-0385 – SET MODULE – SET PORT – SET STATIC_ROUTE – SET LOGICAL_LINK – SAVE ALL|MODULE_PORT

Table 26 (Page 2 of 2). References and Process Quick Guide	
Task	**References**
Monitoring and Troubleshooting	• Use the respective ATM Module Installation and User's Guides – Understanding LEDs – Troubleshooting • *IBM 8260/8285 ATM Command Reference Guide*, SA33-0385 – SHOW MODULE – SHOW MODULE VERBOSE – SHOW PORT – SHOW PORT VERBOSE – SHOW STATIC_ROUTE – SHOW LOGICAL_LINK

6.4 Microcode/Picocode Considerations

The following section describes:

- Reasons for upgrading microcode
- How to acquire the latest microcode
- How to upgrade the microcode

6.4.1 Reasons for Upgrading Microcode

As part of your network operations plan, it is a good practice to include maintaining your network devices with the most recent software/microcode available. This allows you to take advantage of the newest features, to comply with the latest standards, and to interoperate with the widest number of vendors.

The latest microcode levels for the 8285 ATM Control Point are:

- Release 1.3.0
  - Support for the A03-MB155 module.
  - Additional LANE support including support for external LECS via either configured address or dynamic discovery.
- Release 1.4.0

  Release 1.4.0 is a major upgrade. It includes new operating code as well as new microcode for the base unit and all available 8285 modules. New and enhanced features include:
  - Increases the number of connections available per module from 992 to 4064.
  - Allows for variable VPC/VCC value ranges enabling either more paths with fewer channels each, or fewer paths with more channels each.
  - Supports ATM Forum Available Bit Rate (ABR) Service on the ATM 12-Port 25 Mbps UTP Concentrator Module, the ATM 3-Port 155 Mbps LAN Concentration Module, and on the 12-port 25 Mbps base unit.

- Adds PVC support to its multipoint capabilities which were previously SVC only. This includes both permanent virtual circuits and permanent virtual paths. Configuration requires only root and leaf addresses; intervening switches need not be changed.

6.4.2 Acquiring the Latest Microcode

The IBM 8285 Nways ATM Workgroup Switch is designed to easily accommodate evolving standards and additional capabilities. All operating code can be easily upgraded by downloading the code from a TFTP server, either in-band or via a SLIP connection.

These code updates can be obtained from several sources:

- Via the IBM Networking Home Page
- From the PC Company's BBS servers
- Via traditional software support by calling 1-800-237-5511 and ordering P/N 51H4869, EC E28199. Make sure you have your customer number handy.
- Via the TOOLS disk (Internal Use Only)

6.4.2.1 Downloading from the World Wide Web

To download the microcode from the World Wide Web (WWW), you need the following:

- TCP/IP installed and operational on your computer.
- A Web browser to present HTML documents to you. Popular Web browsers include:
  - Netscape Navigator (Windows)
  - IBM Web Explorer (OS/2)
  - Microsoft Internet Explorer (Windows).
- A connection to the WWW via your corporate network or an access provider.

To get the microcode, first load the URL http://www.raleigh.ibm.com/82a/82afix.html in to your Web browser and press Enter. Your Web browser will download the 8285 Microcode Upgrades page for you. You will then be able to:

- Register to receive e-mail notification of 8285 microcode upgrades.
- Download the *8285 Base Unit/Expansion Unit Installation and User's Guide* in 3M Adobe Acrobat *.pdf format.
- Download the README file for the upgrade package.
- Download the 8285 Upgrade Package in ZIP format.
- Download the appropriate Unzip EXECS for your operating system.
- Download the latest code for the 8285/8260 modules that can be installed in the 8285 Expansion Chassis.

6.4.2.2 Downloading from a PC Company Bulletin Board

The PC Company maintains several bulletin boards that contain the latest microcode. You can reach them at the following locations:

1. U.S.: (919) 517-0001
2. Toronto: (905) 316-4255 or (416) 956-7877
3. Vancouver: (604) 664-6464
4. Montreal: (514) 938-3022

Look for the string 8285 in the directory 32. The files are the same as on the Internet.

6.4.2.3 Downloading from an Internal VM Site

8285 microcode is available to IBMers from an internal site. You may access this site by:

- Entering TOOLS at the PROFS command line, and on the next screen:

```
            (c) Copyright IBM Corporation 1996 - All Rights Reserved

Please fill in fields as needed (TOOLS will prompt you for missing values).
 Press ENTER to send request, PF3 to quit, PF5 to send request and then quit.


 Disk/Conference ==> TOOLS 1.        (ATMP disk managed by ATMDESK
at LGEVMXA)



         Request ==> ? 2.           Details:

   Filename/Type ==> ? 3.        ? 4.         *

     Description ==>
```

Note:

1. Alter address to:

disk name ==> ATMBIN

managed by ATMPE

at LGEVMA

2. Change ? to GET.

3. Change ? to one of the following:

- 8285P100 for operational code level 1.0.0
- 8285P101 for operational code level 1.0.1
- 8285P120 for operational code level 1.2.0
- F85HV130 for operational code level 1.3.0
- F85HV140 for operational code level 1.4.0

4. Change ? to PACKAGE.

Press the Enter key, resulting in the screen below. The package will be sent to your reader.

```
Disk/Conference ==> ATMPE       (ATMBIN disk managed by ATMPE at LGEVMA)


        Request ==> GET         Details:

  Filename/Type ==> 8285P120 PACKAGE   *

    Description ==>


          Requesting a copy of "8285P120 PACKAGE"

          GET request for disk ATMBIN sent to ATMPE at LGEVMA (2314)
Any CMS command ==>
```

Each package contains a self-extracting .EXE file for:

- The microcode (both BOOT and OPERATIONAL)
- The FPGA picocode
- Installation instructions
- The release note
- The new 8285 Installation and User's Guide

If you replace GET with LIST and package_name with *, you will get a list of available packages sent to your reader.

- Entering the TOOLS fast path command at the PROFS command line:

```
TOOLS SENDTO LGEVMA ATMPE ATMBIN GET package name PACKAGE
```

where package_name is set to one of the following:

- 8285P100 for operational code level 1.0.0
- 8285P101 for operational code level 1.0.1
- 8285P120 for operational code level 1.2.0
- F85HV130 for operational code level 1.3.0
- F85HV140 for operational code level 1.4.0

Each package contains a self-extracting .EXE file for:

- The microcode (both BOOT and OPERATIONAL)
- The FPGA picocode
- Installation instructions
- The release note
- The new 8285 Installation and User's Guide

If you replace GET with LIST and package_name with *, you will get a list of available packages sent to your reader.

The following tables summarize the various code packages available and the names of their component files.

Table 27. Filenames for System Upgrade Microcode (Release 1.0-1.2)

Component/ Feature Code	Release 1.0	Release 1.0.1	Release 1.2
Field P/N			51H4869
Package Name * PACKAGE	8285P100	8285P101	8285P120
Release Notes (relnote.doc) * LIST3820	8285R100	8285R101	R51H4872
Installation Instructions (install.doc) * LIST3820	8285I100	8285I101	8285I120
Executable File * EXEBIN	8285O101	8285O101	8285O120
Boot			boot120.bin
Operational	oper100.bin	oper101.bin	oper120.bin
FPGA			basfpga3.bin

Table 28. Filenames for System Upgrade Microcode (Release 1.3-1.4)

Component/ Feature Code	Release 1.3	Release 1.4
Field P/N		
Package Name * PACKAGE	F85HV130	F85HV140
Installation Instructions (INST8285.DOC) * LIST3820	I10J1989	I10J1994
Release Notes (REL8285.DOC) * LIST3820	R10J1990	R10J1993
Executable File * EXEBIN	D10J1991 D10J2095	D51H5219
Boot	boot130.bin	boot140.bin
Operational	oper130.bin	oper140.bin
FPGA	8285LEV3.enc	85pgac10.enc
IBM 8285 Base Unit (old)		8285old1.enc

Table 29 (Page 1 of 2). Filenames for Module Upgrade Microcode (Release 1.4)

Feature Code/ Faceplate ID	Description	Filename
5002:A02-MB155	2-port ATM 155 Mbps	1552pc40.enc
5003:A03-MB155	3-port ATM 155 Mbps	1553pc40.enc
5004:A04-FB100 MIC	4-port ATM 100 Mbps	100mc40.enc
5104:A04-FB100 SC	4-port ATM 100 Mbps	100sc40.enc
5008:VDM	Video Distribution	cmpga40.enc

Table 29 (Page 2 of 2). Filenames for Module Upgrade Microcode (Release 1.4)

Feature Code/ Faceplate ID	Description	Filename
5012:A12-TP25 RJ	12-port ATM 25 Mbps	25pga10.enc
5204:A04MB-BRG	ATM TR/Enet Bridge	cmpga40.enc
5302:A02 WAN	ATW WAN	cmpga40.enc
5012:A12-TP25 RJ (old)	12-port ATM 25 Mbps	25old1.enc

6.4.3 Upgrading the Microcode

Warning

Do not proceed without familiarizing yourself with the process detailed in the Installation Instructions for your specific upgrade. The process has been designed to minimize the upgrade effort and to maximize network availability. Use it.

The Installation Instructions are available from the same sources as the microcode.

The general steps required to upgrade your IBM 8285 Nways ATM Workgroup Switch are discussed below. However, be aware that the specific steps and sequence vary for different upgrades. You can find the specific steps detailed in the *Installation Instructions* for your upgrade.

1. Upload the files to your TFTP server. If using a UNIX server, be sure to set the permissions properly using the chmod command:

```
chmod a+r <filename>
```

2. Upload your current configuration to the TFTP server to ensure that there is a backup copy available.

   Reminder

   It is recommended that the following steps be performed with No operational traffic flowing in through the 8285. Normally this operation would be done during a scheduled maintenance period.

3. Download the new microcode from the TFTP server by issuing the appropriate SET TFTP SERVER_IP_ADDRESSS, SET TFTP FILE_TYPE, SET TFTP FILE_NAME, SET TFTP TARGET_MODULE, and DOWNLOAD INBAND commands for each of the following:

   - BOOT microcode
   - OPERATIONAL microcode
   - FPGA microcode

   For the 8285 Base Unit, the TARGET_MODULE will be 1.

Attention

The BOOT and OPERATIONAL code load very quickly (approximately 1 minute each). However, because of extensive error-checking on the FPGA code, it can take more than 10 minutes. Be patient.

4. Download the new microcode for any media modules installed in the 8285 Expansion Chassis by issuing the appropriate SET TFTP SERVER_IP_ADDRESSS, SET TFTP FILE_TYPE, SET TFTP FILE_NAME, SET TFTP TARGET_MODULE, and DOWNLOAD INBAND commands. In this case the TARGET_MODULE number will be slot number that each card is installed in. Be sure to check the current FPGA code first, using the SHOW MODULE n VERBOSE (where n is the blade's slot number).

```
8285> set tftp server_ip_address 9.100.86.130
TFTP server set.
8285> set tftp file_type boot
File type set
8285> set tftp file_name
Enter file name:
/usr/binatm/boot140.bin
File name set
8285> show tftp

TFTP Parameters:
Server IP address    : 9.100.86.130.
File Name            : /usr/binatm/boot140.bin.
File type            : Boot.
Last Transfer Date   : 19 Mar 96.
Last Transfer Result : This file has not been transferred yet.
8285> show device
 1
⋮
Manufacture id: 53-
Part Number: 58G9605 EC Level: C38846
Serial Number: LAG050
Boot EEPROM version: g.1.0.6
Flash EEPROM version: v.1.0.0
Flash EEPROM backup version: Y.1.0.0
Last Restart : 13:30:25 Tue 1 Oct 96 (Restart Count: 93)
⋮
8285> ping 9.100.86.130
 2
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.86.130: 1 packets sent, 1 received
Ping 9.100.86.130: 2 packets sent, 2 received
8285> download inband
You are about to download a new version.
Are you sure ? (Y/N) Y
Download successful.
 3
8285> show tftp

TFTP Parameters:
Server IP address    : 9.100.86.130.
File Name            : /usr/binatm/boot140.bin.
File type            : Boot.
Last Transfer Date   : 1 Oct 96.
Last Transfer Result : OKAY.
 4
8285> show device
⋮
Manufacture id: 53-
Part Number: 58G9605 EC Level: C38846
Serial Number: LAG050
Boot EEPROM version: v.1.4.0
Flash EEPROM version: v.1.0.0
Flash EEPROM backup version: Y.1.0.0
Last Restart : 13:30:25 Tue 1 Oct 96 (Restart Count: 93)
```

Note:

1 Check current boot and operational microcode levels.

2 Check to see that the TFTP server is reachable.

3 Download successful indicates a successful download. Had the download been unsuccessful, Download failure : Error. would have been the messages.

4 OKAY. indicates a successful download. Had the download been unsuccessful, Error. would have been the message.

Now we repeat the process for the operational code and the FPGA code, using the same SET TFTP FILE_TYPE, SET TFTP FILE_NAME, DOWNLOAD INBAND sequence as for the boot code.

Once you have successfully downloaded the FPGA code for the base unit (that is, module 1) and for each module, you can use the SHOW MODULE VERBOSE command to check each module's FPGA levels, as shown below:

```
8285> show module 1 verbose
⋮
P/N:58G9605 S/N:LAG050
EC level:C38846 Manufacture: 53-
Operational FPGA version : 2
     Backup FPGA version : C10 1

8285> show module 2 verbose
⋮
ATM Carrier Module Information:
------------------------------
P/N:51H3862  EC level:E28091  Manufacture:VIME
Operational FPGA version : B3F3(BAD LEVEL) 2
     Backup FPGA version : B40
```

Note:

1 C10 indicates that the correct FPGA code is in the backup FPGA, ready to be swapped.

Other possible values include:

- None indicating that no valid code is available to be swapped. This may occur on both the IBM 8285 Base Unit and the ATM 12-Port 25 Mbps UTP Concentrator Module. The correct action to take is to download the FPGA code for that module again. Do not proceed with swapping microcode until you have valid microcode in the backup FPGA for each module to be swapped.

2 (BAD LEVEL) is indicated because the current and backup microcode levels are incompatible. Note that the correct code level is in the backup FPGA, ready to be loaded.

Please note that it is the backup FPGA that is updated, not the operational FPGA.

Table 30. Download Errors and Suggested Fixes

Symptom	Possible Cause	Suggested Actions
Ping failure	TFTP server unreachable via a TCP/IP connection.	• Check if server is on. • Check if server has TCP/IP running. • Validate all cable connections (continuity, polarity, etc.) • Make sure ports are properly enabled. • Check if ARP server has registered 8285. See section **** for how to do this. • Check IP subnetting to ensure both devices are in the same subnet.
Download failure	TFTP not enabled on the server.	Enable TFTP on server and/or start TFTP daemon.
	R/W permissions improperly set on a UNIX server.	• Login to the TFTP server • Change to the directory the upgrade files reside in • Change the file permissions using the CHMOD a+r <filename> command
	Corrupted upgrade files.	Download the files again, making sure that you are downloading them as binary files.

5. To activate the new microcode, it is necessary to swap the operational microcode with the backup microcode, using the SWAP MICROCODE command and the SWAP FPGA_PICOCODE command. Don't forget to SAVE ALL first as the SWAP will reset the subsystem and any unsaved changes will be lost.

Reminder

This must be performed with No operational traffic flowing in through the 8285. Normally this operation would be done during a scheduled maintenance period.

```
8285> save all 1
8285> swap microcode
You are about to change operational microcode version and reset the hub.
The saved hub configuration may be lost..
Are you sure ? (Y/N) Y

Migration allowed; checking for needed FPGA swaps
Some SWAP FPGA commands will be executed now...
Generated command: SWAP FPGA 1 ... 2
Press Enter
⋮
(system reboots)
⋮
8285> save all 1
8285> swap fpga_picocode 2 3
You are about to change operational FPGA version..
Are you sure ? (Y/N) Y
Processing slot  2 ... Swap completed. 2
```

Note:

1 Save configuration changes before starting.

2 SWAP FPGA message will be generated for each module being upgraded.

3 SWAP FPGA_PICOCODE slot command entered to swap microcode levels on the module in slot 2.

Table 31. Swap Errors and Suggested Fixes

Symptom	Possible Cause	Suggested Actions
Failure. Prompt=" > > nnnn > > ".	The 8285 ATM Control Point was unable to find FPGA code that was valid with its operational code, and has reverted to maintenance mode.	You must restore the 8285s operational code and configuration. • Use the SWAP ACTIVE command to restore the previous operational microcode. • Use the BOOT command to restart the system. • Re-enter your configuration information. • Re-enter your TFTP configuration information. • Repeat the download and swap process.

```
8285> swap microcode
You are about to change operational microcode version and reset the hub.
The saved hub configuration may be lost..
Are you sure ? (Y/N) Y

Migration allowed; checking for needed FPGA swaps>> 0050 >>
>> 0050 >> swap active
Changed.
>> 0050 >> boot
Booting...
```

6. Check the new levels of code, by using the SHOW DEVICE and SHOW MODULE slot VERBOSE commands. Items to pay attention to include the:
   - Boot EEPROM version (see item 2 in the example below)
   - Flash EEPROM version (just below the Boot EEPROM version)
   - Operational FPGA version (see item 5 in the example below)

```
8285> show device 1
8285 Nways ATM Workgroup Switch
⋮
Manufacture id: 53-
Part Number: 58G9605 EC Level: C38846
Serial Number: LAG050
Boot EEPROM version: v.1.4.0 2
Flash EEPROM version: v.1.4.0
Flash EEPROM backup version: v.1.0.0 3
Last Restart : 09:33:50 Fri 4 Oct 96 (Restart Count: 3)
⋮
8285> show module 1 verbose 4
⋮
P/N:58G9605 S/N:LAG050
EC level:C38846 Manufacture: 53-
Operational FPGA version : C10 5
     Backup FPGA version : 2(BAD LEVEL)
⋮
8285> show module 2 verbose 4
⋮
ATM Carrier Module Information:
------------------------------
P/N:51H3862  EC level:E28091  Manufacture:VIME
Operational FPGA version : B40 5
     Backup FPGA version : B3F3(BAD LEVEL)
8285> ping 9.100.86.130 6
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.86.130: 1 packets sent, 1 received
Ping 9.100.86.130: 2 packets sent, 2 received
```

Note:

1 SHOW DEVICE to check microcode levels.

2 Both the Boot and the Flash EEPROMs are at the correct level.

3 The old flash microcode is now stored in the flash backup EEPROM.

4 Check the FPGA levels using the SHOW MODULE VERBOSE command.

5 The FPGA is at the correct level. The old FPGA has been swapped to the Backup FPGA. Since it is not compatible with the current code, it is indicated as (BAD LEVEL).

6 Test network connectivity by PINGing.

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Chapter 7. IBM 8285 Configuration

This chapter provides information on how to configure 8285 Classical IP devices and LAN Emulation. ELAN parameters are also listed in this chapter, as well as configuration instructions to troubleshoot the LANE.

7.1 Configuring Classical IP

To allow the 8285 ATM Control Point to communicate with Classical IP (CIP) devices, it is necessary to configure and enable CIP on it.

7.1.1 Classical IP Parameters

The minimal set of parameters you will need in order to configure CIP are:

ATM address This is the 20-byte ATM address to be assigned to the switch's CIP interface. This address is comprised of five basic parts:

1. ATM network prefix (bytes 1-11)
2. ATM cluster number(ACN) (byte 12)
3. ATM hub number (AHN) (byte 13)
4. End station identifier (ESI) (bytes 14-19)
5. ATM selector (byte 20)

ARP server The ATM address of the ARP server with which to register. The ARP server will be used for resolving CIP IP addresses in to ATM addresses.

IP address The IP address assigned to the switch. This must be unique.

Subnet mask The mask used to allocate the IP address bits. Must match the mask used by the default gateway.

Default gateway The address to forward packets to to reach other IP networks.

7.1.2 Configuring a Simple CIP Network

The figures below show a simple CIP network, both physically and logically, comprised of an IBM 8285 Nways ATM Workgroup Switch and an ARP server.

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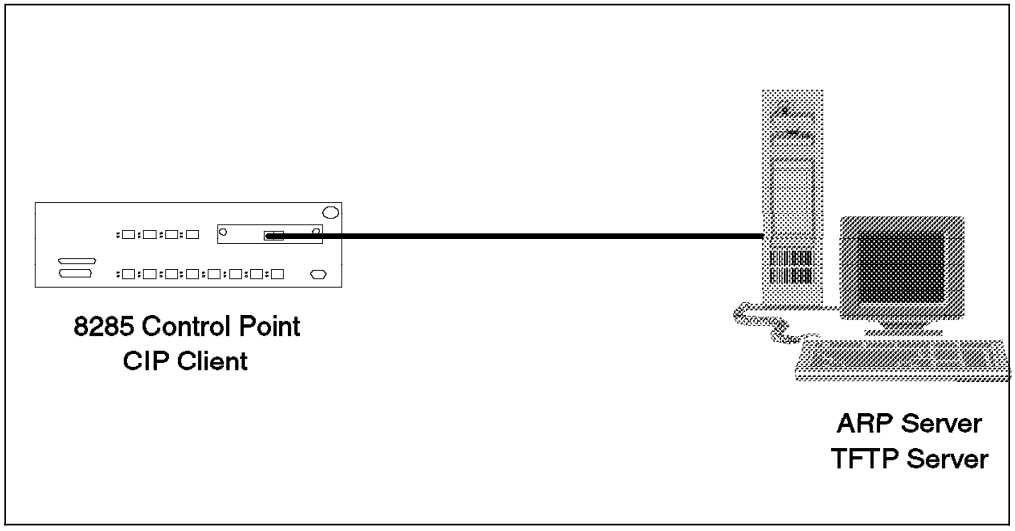

Figure 38. Simple CIP Network - Physical View

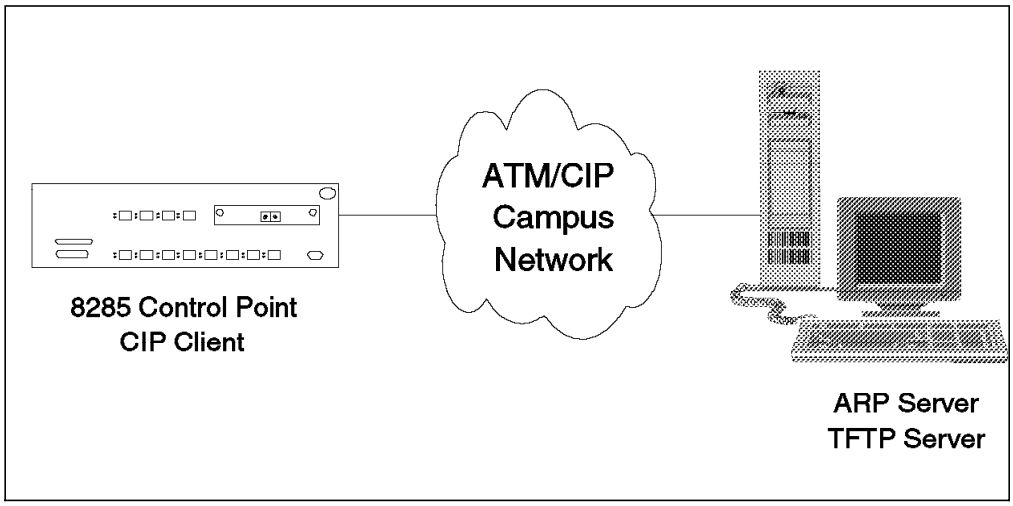

Figure 39. Simple CIP Network - Logical View

The parameters we use in our example are listed in Table 32. Because we have only a single switch, both the 8285 ATM Control Point and the ARP server are in the same logical ATM network and share the same ATM network prefix, cluster number, and hub number. They are also part of the same IP subnetwork, so that they can communicate directly with each other.

Table 32 (Page 1 of 2). Necessary Parameters for 8285 #1

Parameter	Value	Comments
IP address	9.100.86.150	
Subnet Mask	FF.FF.FF.C0	Must be entered in dotted hexadecimal.
Default Gateway	9.100.86.130	
ATM prefix	3999999999999900009999	First 11-bytes of address.
ACN	01	12th byte.
AHN	01	13th byte.

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Table 32 (Page 2 of 2). Necessary Parameters for 8285 #1

Parameter	Value	Comments
ATM ESI	999999999901	6-byte MAC address.
ATM Selector	00	Has significance only to local workstation. Should be set to 00.
ARP Server ESI	08005A99029F	6-byte MAC address.
ARP Server Selector	00	Must explicitly match the ARP server's value.

The commands we will need are:

- SET DEVICE IP_ADDRESS
- SET DEVICE DEFAULT_GATEWAY
- SET DEVICE ARP_SERVER
- SAVE ALL
- SET DEVICE ATM_ADDRESS
- SET PORT

The reason why SAVE ALL precedes SET DEVICE ATM_ADDRESS is that the latter forces a reset of the ATM subsystem. You will be warned first, but if you forget to save the parameters you have just entered, they will be lost; only the ATM address will change.

Below is an annotated transcript of the commands used to configure and test our simple network.

```
8285> set device ip_address atm 9.100.86.150 FF.FF.FF.C0 1
IP address and mask set
8285> set device default_gateway 9.100.86.130 2
Default gateway set
8285> set device arp_server 3
Enter ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.01.08.00.5A.99.02.9F.00
8285> save all 4
8285> set device ATM_address 5
Enter ATM address : 39.99.99.99.99.99.99.00.00.99.99.01.01.99.99.99.99.99.01.00
This call will reset the ATM subsystem.
Are you sure ? (Y/N) y
8285 Nways ATM Workgroup Switch
(C) Copyright IBM Corp. 1996. All rights reserved.

Password:

Welcome to system administrator service on 8285.
8285> set port 1.13 enable uni 6
8285> show port 1.13


     Type  Mode      Status
-------------------------------------------------------------------------------
 1.13:UNI enabled  UP-OKAY
8285> ping 9.100.86.130 7
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.86.130: 1 packets sent, 1 received
Ping 9.100.86.130: 2 packets sent, 2 received
Ping 9.100.86.130: 3 packets sent, 3 received
```

Notes:

1 Set the 8285 ATM Control Point CIP IP address and subnet mask.

2 Set the 8285 ATM Control Point CIP IP default gateway.

3 Set the 8285 ATM Control Point ARP Server ATM address. This is the address which ARP requests will be sent to to determine the ATM address of other CIP devices.

4 Save the configuration changes before entering the 8285 switch's ATM address.

5 Set the 8285 switch's ATM address. This forces a reset of the 8285 switch.

6 Enable the port, port 13, that the ARP server is connected to.

7 Test connectivity by pinging the ARP server.

7.1.3 Troubleshooting Your CIP Network

There are relatively few entities in a CIP network that could cause you problems. However, should you be unable to reach other CIP devices, the following items should be considered:

- Check the ARP server to see that you have registered with it. The procedure for doing so is described below in 7.1.3.1, "Checking ARP Server for Registration" on page 127.

- If so, check the IP parameters you configured on the 8285 ATM Control Point to ensure that they are correct. Pay particular attention to your IP subnet and your IP subnet mask.
- If you are not registered with the ARP server, try the steps outlined in 7.1.3.2, “Correcting ARP Registration.”

7.1.3.1 Checking ARP Server for Registration

If you are unable to ping the ARP server or any other IP device, check to see if the ARP server is properly registering your IP and ATM addresses.

For AIX ARP servers, this can be checked in two ways:

1. Using SMIT, the Systems Management Interface Tool
2. Using the fast path command arp -t atm -a

Checking ARP Registration via SMIT

To check ARP registration via SMIT, perform the following steps:

1. Log on to the server as root.
2. Key in smit or smitty (the character-based version) and press Enter.
3. Select the following menu items in sequence:
   - Communications Applications and Services
   - TCP/IP
   - Further Configuration
   - Network Interfaces
   - List SVCs over an ATM 100 Network or ″List SVCs over an ATM 155 Network″ depending on your interface

Checking ARP Registration via Fast Path Command To check ARP registration via the fast path command, perform the following steps:

1. Log on to the server as root.
2. Key in the command:

```
arp -t atm -a
```

7.1.3.2 Correcting ARP Registration

If the ARP server is not registering your 8285 CIP information, but is registering other CIP devices, try re-initializing the 8285 CIP function by re-entering the SET DEVICE ARP_SERVER command. This will force the 8285 ATM Control Point to go through the CIP registration process again.

If you are still not able to register, check the ARP server address you keyed in and be sure that all 20 bytes of the address explicitly match the ARP server′s address.

You have now completed a simple CIP network. You could add additional workstations to the switch. Or you might choose to extend your network by adding another switch.

7.1.4 Configuring a Local Multi-Switch Network for CIP

In this scenario, we add another 8285 to our network, representing perhaps a departmental work group on a different floor. To accommodate the new high-speed connection, we add an 8285 Expansion Chassis to our base configuration. Now our network diagram looks like the following:

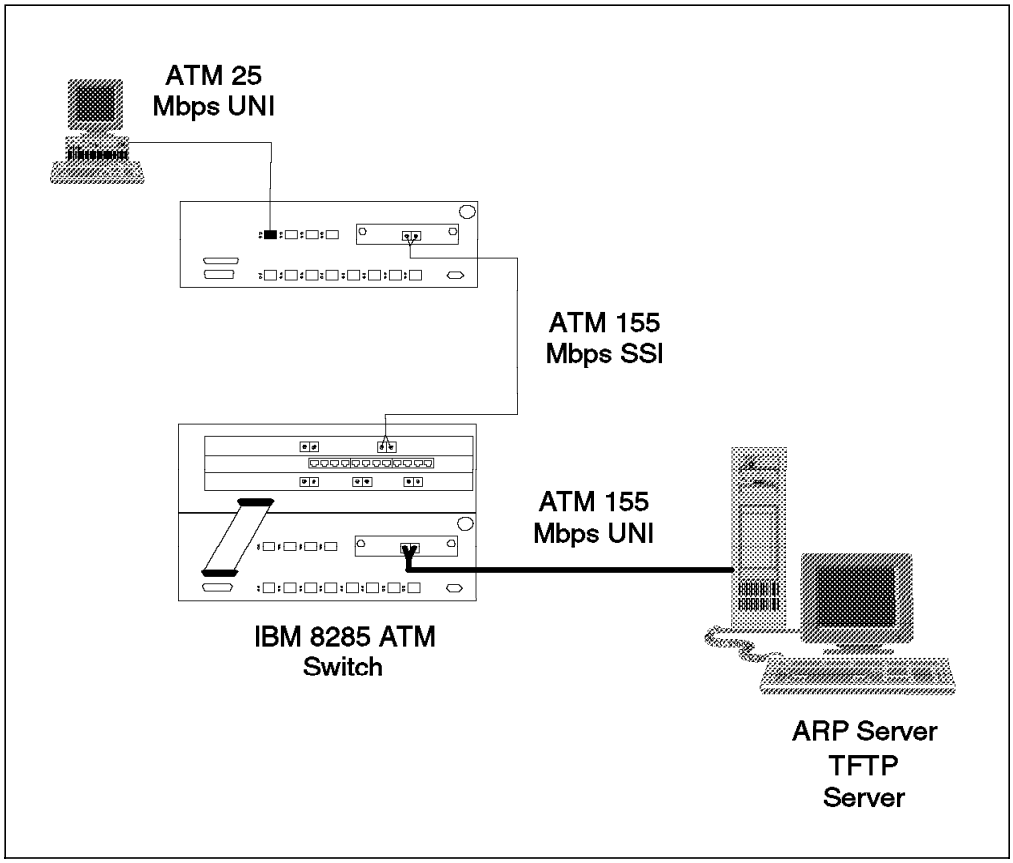

Figure 40. Multi-Switch CIP Network - Physical View

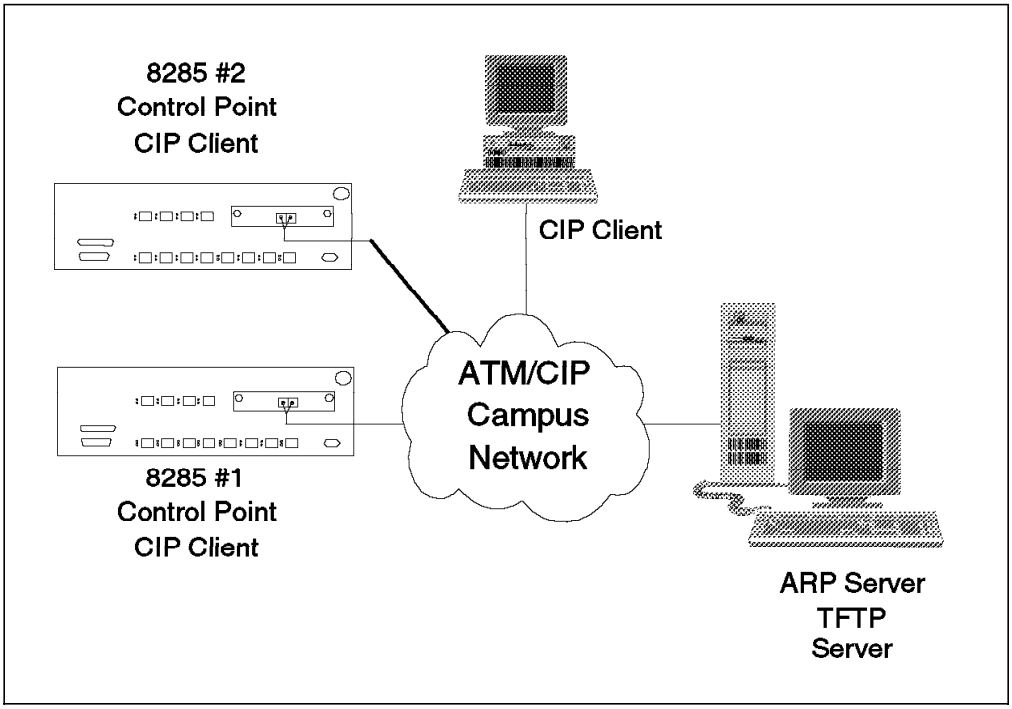

Figure 41. Multi-Switch CIP Network - Logical View

The necessary parameters for our second switch are listed below in Table 33. Please note that the ACN is the same, indicating that both switches are in the same cluster and will therefore communicate using SSI protocols.

Table 33. Necessary Parameters for 8285 #2

Parameter	Value	Comments
IP address	9.100.86.151	
Subnet mask	FF.FF.FF.C0	Must be entered in dotted hexadecimal.
Default gateway	9.100.86.130	
ATM prefix	399999999999900009999	First 11-bytes of address. Must match 8285 #1.
ACN	01	12th byte. Must match 8285 #1.
ATM hub number	02	13th byte. Must be unique within cluster.
ATM ESI	999999999902	6-byte MAC address.
ATM selector	00	Has significance only to local workstation.
ARP server ESI	08005A99029F	6-byte MAC address.
ARP server selector	00	Must explicitly match the ARP server's value.

We configure the second switch just as we did the first one, however for the sake of brevity, we show only the commands that are new for thi s scenario.

To enable connectivity between the switches, we configure an SSI connection between them. This is done using the SET PORT command:

```
8285> set port 1.13 enable ssi 155000
```

When setting up your SSI parameters, make certain that you satisfy the following conditions:

1. The ATM network address (the first 11 bytes of the ATM address) for each switch is the same.
2. The ATM cluster number (11th byte of the ATM address) is the same on each switch.
3. The hub numbers (13th byte of the ATM address) are different.

Even though the port may be physically up, that is receiving and transmitting properly, if it is misconfigurated, it will be reported as being not in service. If this happens, The 8285 will try to provide helpful error messages in the IX Status field returned by the SHOW PORT command with the VERBOSE option.

```
8285> show port 1.13 verbose

     Type  Mode      Status
-------------------------------------------------------------------------------
 1.13:SSI enabled  UP-NOT IN SERVICE

SSI Bandwidth        : 155000 Kbps
Connector            : SC DUPLEX
Media                : Multimode fiber
Port speed           : 155000 Kbps
Remote device is active
IX status            : HUB numbers identical
Scrambling mode      : frame and cell
Clock mode           : internal
```

A list of some of these messages is given in Table 34.

Table 34 (Page 1 of 2). IX Status Messages and Causes

IX Status Message	Possible Causes	Suggestions
IX OK	Link is configured properly and active.	None.
Attached to non SSI port	Remote device is not configured to support the SSI protocol.	Disable the remote port, then enable it for SSI.
Hub numbers identical	Both switches have the same ATM network prefix.	Change the ATM address of one of the switches so that at least the hub number is different.

Table 34 (Page 2 of 2). IX Status Messages and Causes

IX Status Message	Possible Causes	Suggestions
ACN mismatch	Each switch has a different ATM cluster number.	• Change the ATM address of one of the switches so that both have the same cluster number. • Set each end of the link to use NNI protocols if connecting different clusters.

That is basically all that is required to configure a simple ATM CIP network.

7.2 Configuring LAN Emulation

The IBM 8285 Control Point can provide the Forum-Compliant LAN Emulation server functions (LES/BUS) and the client (LEC) function. To enable these functions on the 8285 ATM Control Point, it is necessary to configure and enable LAN Emulation on it.

7.2.1 8285 LAN Emulation Functions Overview

The IBM 8285 Control Point can provide the Forum-Compliant LAN Emulation server functions (LES/BUS) and the client (LEC) function. It supports up to two LES/BUSe simultaneously with any combinations of ELAN types, such as two token-ring ELANs (TR/LEs), two Ethernet ELANs (ETH/LEs), and one TR/LE and one ETH/LE. In addition, it supports both TR and ETH LECs simultaneously but it cannot have two LECs with the same ELAN type.

7.2.2 LAN Emulation Parameters

The only parameters you will need in order to configure LAN Emulation functions are:

- **ATM Address**

  This is the 20-byte ATM address to be assigned to the switch's LEC and LES/BUS components as well as its to CIP interface. This address is comprised of five basic parts:

  1. ATM network prefix (bytes 1-11)
  2. ATM cluster number (ACN) (byte 12)
  3. ATM hub number (HN) (byte 13)
  4. End station identifier (ESI) (bytes 14-19)
  5. ATM selector field (SEL) (byte 20)

  In the IBM 8285 there is only one command, SET DEVICE ATM_ADDRESS, to define the ATM address and it is to configure the ATM address for the CIP interface. The addresses of LAN Emulation components are automatically assigned based on the CIP interface address by changing the selector field of it. Table 35 on page 132 shows the Forum-Compliant LAN Emulation addresses are assigned.

Table 35. Address Assignment Rule for the IBM 8285 Nways ATM Workgroup Switch LAN Emulation Components

ATM Component	Selector Value	Example
CIP address	00	39999999999999000099 99010999999999909**00**
Ethernet LEC	00	39999999999999000099 99010999999999909**00**
Token-Ring LEC	01	39999999999999000099 99010999999999909**01**
1st LES/BUS	02	39999999999999000099 99010999999999909**02**
2nd LES/BUS	03	39999999999999000099 99010999999999909**03**

As a result, the LES and BUS on an ELAN use the same ATM address and the CIP interface address may be in conflict with one of the LANE components' addresses. These ATM address duplications are supported by the IBM 8285 and also by the *The ATM Forum* standard.

Note

As to the ATM address sharing of LANE servers, *The ATM Forum* standard is defined as follows:

An LES may share an ATM address with an ATM address with a BUS on the same ELAN. An operational LES must not share an ATM address with any LANE components other than a BUS, even if two LANE components are co-located and share the use of a UNI. In particular, two LES for different ELANs must not share an ATM address.

- **LES/BUS Parameters**

  The integrated LES/BUS supports Forum-Compliant LAN Emulation LES/BUS functions with or without an external LECS. It supports all higher layer protocols of Forum-Compliant LAN Emulation, such as TCP/IP, IEEE 802.2 protocols and NetWare.

  To configure the LES/BUS, use the SET LAN_EMUL SERVER command with the following parameters:

  – **Server ID**

    Specify the designated LES/BUS identifier to issue the command. The valid options are 1 or 2.

  – **START / STOP**

    Start or stop the designated LES/BUS. When the command is to stop the server, the following parameters are not needed.

  – **ELAN Type**

    Specify the ELAN type of the designated LES/BUS. The valid options are ETH (Ethernet LANE) or TR (token-ring LANE). When the ELAN type of the LES/BUS is Ethernet, it always supports both Ethernet types, 802.3 and DIX/Ethernet V2; you cannot make it support only either type.

  – **Maximum Number of the Clients**

Specify the maximum number of LECs supported by the designated LES/BUS. The maximum number is 128 and is the sum of both LES/BUSes when two LES/BUSes are configured.

– **Maximum SDU Size**

Specify the maximum AAL-5 service data unit (SDU) size supported by the designated LES/BUS. The SDU is the information part of AAL-5 protocol data unit (PDU). The possible values are 1516, 4544, 9234 and 18190 (default: 1516) regardless the ELAN type.

Note

On a real Ethernet network, the maximum data frame length is 1492 or 1500 bytes. However, up to 18190-byte frames are supported on an ELAN as stated above. You may know the inconsistency with the length field in an IEEE 802.3 frame which should be less than 1536 (X'0600'). But the inconsistency is resolved on the the IEEE 802.3 LANE by placing the value 0 in the length field when the IEEE 802.3 LANE frame is longer than 1536.

On the other hand, you must specify 1516 for the maximum SDU size when your ATM network attached to a real Ethernet network via an ATM bridge which doesn't have fragment capability.

– **ELAN Name**

Specify the Emulated LAN name. The default value is IBM_lantype_LANn, with lantype set to ETHERNET or TOKEN_RING based on the ELAN type, and n set to 1 or 2 based on the server ID. For example, the default ELAN name for the Ethernet LES/BUS with server ID 1 is IBM_ETHERNET_LAN1.

• **LEC Parameters**

The integrated LEC function supports the TCP/IP protocol over Forum-Compliant LAN Emulation and provides a node management interface to a Telnet station or to a SNMP manager.

To configure the LEC, use the SET DEVICE LAN_EMULATION_CLIENT command with the following parameters:

– **ELAN Type**

Specify the ELAN type to which the LEC belongs. The valid options are ETH (Ethernet LANE) or TR (token-ring LANE).

– **Ethernet Type**

Specify the Ethernet type when the ELAN type is Ethernet. The default setting is 802.3 and the Ethernet type should be the same as the communicating device. Note that there are many devices that have the other Ethernet type (DIX/Ethernet V2) as the default.

– **IP Address**

The IP address to be assigned to the switch. This must be unique. And if the IBM 8285 is configured with multiple IP addresses, they have to be on different IP networks because they are treated as the IP interfaces of an IP node.

Note

There is a well-known restriction that the IP interfaces of the IBM 8285 and the IBM 8260 should not use IP network number 10 because it is use d on their internal network. This restriction applies not only to the CIP interface of the IBM 8285 but also to that of the LECs. It is planned to remove this restriction when the control point code supports PNNI phase 1, expected in 1997.

– **Subnet Mask**

  The mask used to allocate the IP address bits. Must match the mask used by the default gateway.

– **Default Gateway**

  Specify the address to forward packets to to reach other IP networks when communicating with an IP device beyond the IP network. In the LANE network, the default gateway should be an IP router on the same ELAN of the IP device or on a legacy LAN via a LANE bridge on the same ELAN.

– **Individual MAC Address**

  Specify the individual MAC address of the LEC. The address format should be canonical for Ethernet ELAN and non-canonical for token-ring ELAN and both universal and local administered address (UAA/LAA) are supported. It should be unique throughout the transparent bridging network and in a source routing bridging segment just like the MAC address on a legacy LAN.

– **Associated LES or LECS ATM address**

  Specify the ATM address of the LES with which to register or the LECS which knows the ATM address of a designated LES. The LES will be used for resolving ELAN MAC addresses in to ATM addresses.

  To get the designated LES ATM address, the following options are offered:

  - Use a pre-defined LES ATM Address

    If you don't have the LECS on the ELAN, you have to specify the LES ATM address in each LEC definition.

    When the 8285 LEC is attached to this type of ELAN, the SET DEVICE LAN_EMULATION_CLIENT command with the parameter NO_LECS_WITH_LES followed by the LES ATM address is used to pre-define the LES ATM address.

  - Use a pre-defined LECS ATM address

    If you have the LECS on the ELAN but don't want to use dynamic address resolution, you can specify the LECS ATM address on each LEC definition.

    When the 8285 LEC is attached to this type of ELAN, the SET DEVICE LAN_EMULATION_CLIENT command with the parameter NO_LES_WITH_LECS followed by the LECS ATM address is used to pre-define the LECS ATM address.

  - Use a dynamic LECS ATM address

It is not necessary to pre-define the LECS′ address on each LEC definition if you have a LECS since the mechanisms by which the LECs dynamically use a specific ATM address of the LECS are standardized.

When the 8285 LEC is attached to this type of ELAN, the SET DEVICE LAN_EMULATION_CLIENT command with the parameter NO_LES_WITH_LECS followed by NONE is used to get the LECS ATM address dynamically. The IBM 8285 will search for the LECS ATM address, first using ILMI. If it does not find it, then it will try using the LECS well-known address (WKA) as specified in the standard. To use the dynamic LECS ATM address resolution, you must not forget to define the specific ATM address of LECS in the IBM 8285 definition using the SET LAN_EMUL CONFIGURATION_SERVER command.

The LEC automatically starts when the SET DEVICE LAN_EMULATION_CLIENT command is issued and it cannot be stopped after starting. If you really need to clear the LEC parameters, you should clear the parameters using CLEAR CONFIGURATION command in maintenance mode.

- **LECS / IBM 8285 Addressing**

  The IBM 8285 doesn′t have the LECS but does interwork with the external LECS. When you have an external LECS and resolve the specific ATM address of LECS dynamically, such as using ILMI and well-known Address (WKA), you have to define the real ATM address of it to register it on the LECS address table in the IBM 8285.

  To register the real ATM address of LECS, use the SET LAN_EMUL CONFIGURATION_SERVER command with the following parameter:

  – ACTIVE_WKA or INACTIVE_WKA

    The LECS address table contains an ATM address to be substituted for the WKA. You can define the specific ATM address of WKA as Active WKA. In an 8285, you can define only one active WKA entry. But you can also define 4 Inactive WKA entries in addition. The ACTIVE_WKA or INACTIVE_WKA option is followed by the specific ATM address of it. The ACTIVE_WKA option replaces current Active WKA.

    Note

    As described above, the SET LAN_EMUL CONFIGURATION_SERVER command is used to define the specific ATM address of LECS for ILMI MIB. Then the active WKA has no meaning and all entries defined on the table are included in the MIB in the order of index (Index 1 should be top of the ILMI MIB entries). It means that you can have LECS redundancy by defining multiple LECSs, which have the same configuration on the IBM 8285/8260s in your campus ATM network.

7.2.3 Configuring a Simple LANE Network

Figure 42 on page 136 and Figure 43 on page 136 show a simple LANE network, both physically and logically, comprised of an IBM 8285 and workstations.

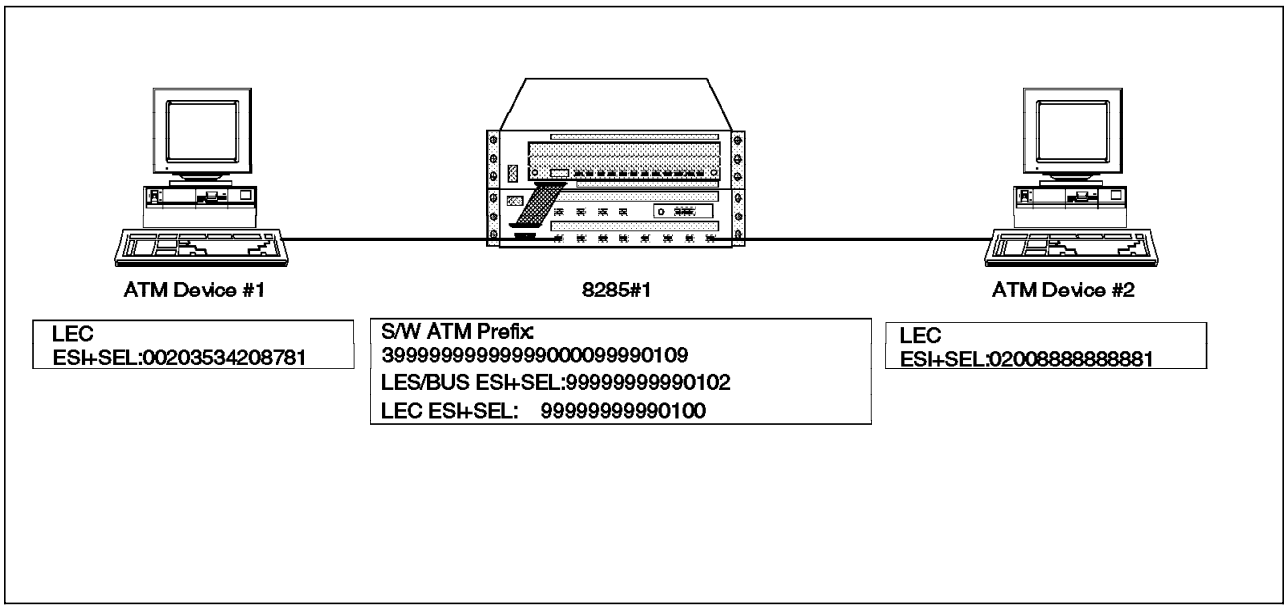

Figure 42. A Simple LANE Network - Physical View

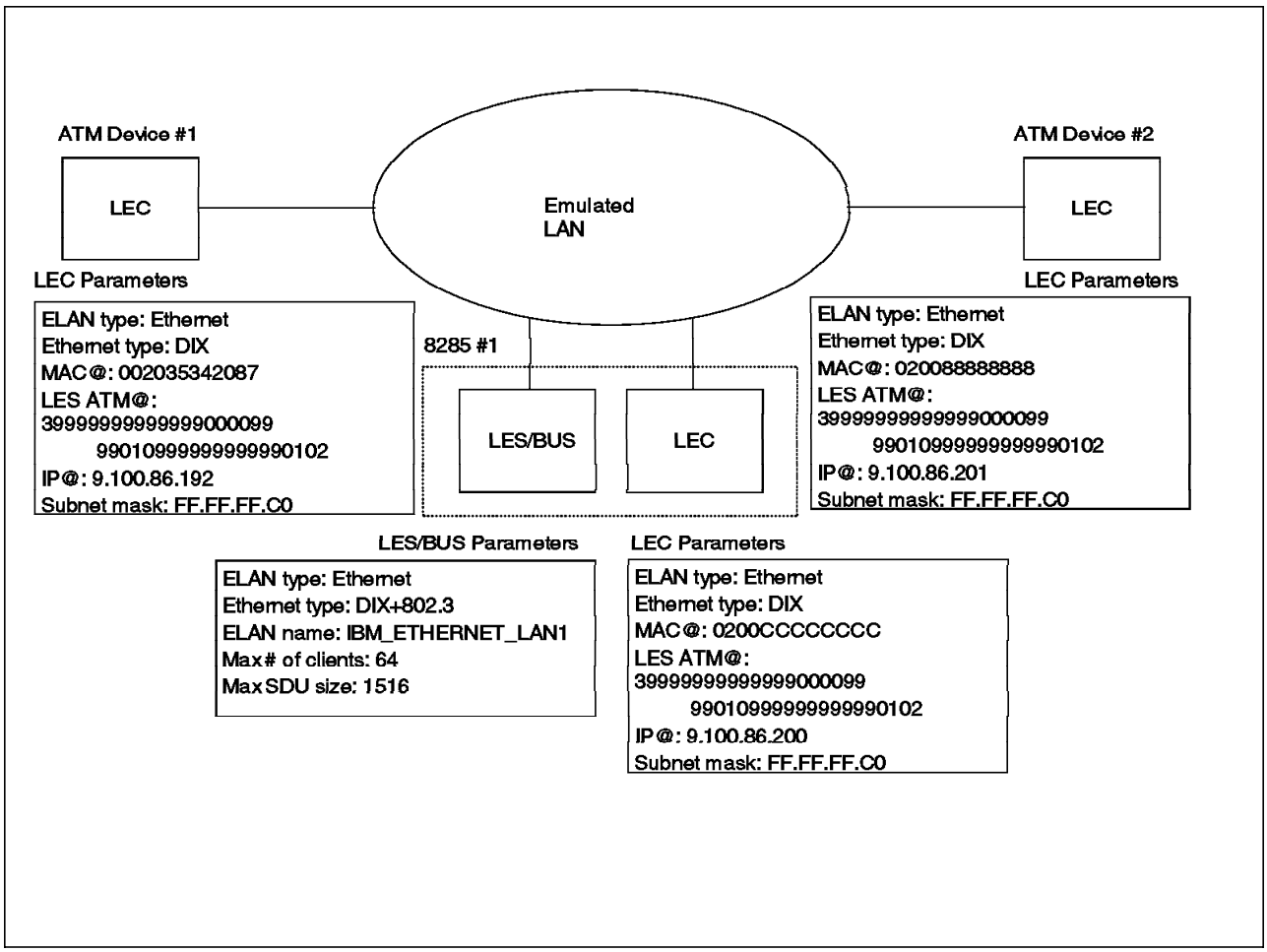

Figure 43. A Simple LANE Network - Logical View

To configure a simple LANE network, the following parameters are needed:

- 8285 ATM address

- 8285 LEC parameters
- 8285 Integrated LES parameters
- ATM module and port parameters

The parameters we use in our example are listed in Table 36.

Table 36. Necessary Parameters for 8285#1

Parameter	**Value**	**Comments**
ATM Address		
ATM Prefix	399999999999900009999	First 11 bytes of address
ACN	01	12th byte, should not be 0
HN	09	13th byte, should not be 0
ESI	999999999901	6-byte MAC address
SEL	00	20th byte
8285 Integrated LES parameters		
Server ID	1	
ELAN type	Ethernet	
Max # of clients	64	
Max SDU size	1516	Default
ELAN name	IBM_ETHERNET_LAN1	Default
8285 LEC parameters		
ELAN type	Ethernet	
Ethernet type	DIX	
IP address	9.100.86.200	
Subnet Mask	FF.FF.FF.C0	
Default Gateway	0.0.0.0	Not specified because not used in this configuration
MAC address	0200CCCCCCCC	Canonical format
Associated LES or LECS ATM address	39999999999999000099 99010999999999990102	Use pre-defined LES ATM address (NO_LECS_WITH_LES)

The commands we need are:

- SET DEVICE ATM_ADDRESS
- SET LAN_EMUL SERVER
- SET DEVICE LAN_EMULATION_CLIENT
- SET PORT

The SET DEVICE ATM_ADDRESS command causes the ATM subsystem to reset, so you have to save the configuration using SAVE ALL command if there are unsaved parameters.

Figure 44 on page 138 is an annotated transcript of the commands used to configure and test our simple LANE network.

```
8285 Nways ATM Workgroup Switch
(C) Copyright IBM Corp. 1996. All rights reserved.

Password:

Welcome to system administrator service on 8285.
8285> set device atm_address
Enter ATM address : 39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99
This call will reset the ATM subsystem.
Are you sure ? (Y/N) Y

Press Enter 1



8285 Nways ATM Workgroup Switch
(C) Copyright IBM Corp. 1996. All rights reserved.

Password:

Welcome to system administrator service on 8285.
8285> set device lan_emulation_client
Enter lan type: eth ip_address:9.100.86.200 subnet_mask:ff.ff.ff.c0
Some parameters are missing. Client state unchanged. 2
8285> set device lan_emulation_client
Enter lan type: eth no_lecs_with_les:
Enter address : 39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.01.02
Some parameters are missing. Client state unchanged.
8285> set device lan_emulation_client
Enter lan type: eth mac_address:020OCCCCCCCC
Client starting. 3
8285> set device lan_emulation_client eth eth_type:DIX 4
Client starting.
8285> set lan_emul server 1 start eth 64
Enter emulated LAN name:

Starting server. 5
8285> set port 1.1 enable uni
 1.01:Port set
8285> set port 1.8 enable uni
 1.08:Port set 6
8285> ping 9.100.86.192
Starting ping (hit CTRL-C to stop) ...
Ping 9.100.86.192: 1 packets sent, 1 received
Ping 9.100.86.192: 2 packets sent, 2 received
8285>
```

Figure 44. The Console Screen of a Simple LANE Network Configuration

Notes:

1 With control point V1.3 or later, the 8285 switch uses this message to tell you when the ATM subsystem reset is finished.

2 The LEC in the IBM 8285 doesn't start until you define the necessary parameters and this message appears. But the parameters you define are reflected.

3 The LEC in the IBM 8285 starts as soon as it gets the necessary parameters.

4 You may change the Ethernet type of the LEC in the IBM 8285 because the default is 802.3 and many devices use DIX as the default.

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5 The integrated LES/BUS is started. The LEC in the IBM 8285 automatically registers with it.

6 The ports attached the LECs are enabled. They are now ready to connect ATM devices. Note that many LECs should be started after the LES/BUS has been up because they have retry counts which limit how many times they may issue the LANE registration request.

7.2.4 Troubleshooting Your LANE Network

There are relatively few entries in a LANE network that could cause you problems. The following sections describe the typical items that should be considered:

- Check the Physical (ATM) Connection
- Check the LANE Registration
- Other Considerations

For more information about troubleshooting your LANE network, refer to the troubleshooting chapter of *IBM 8285 Nways ATM Workgroup Switch: Installation and User's Guide*.

7.2.4.1 Check the Physical (ATM) Connection

When you connect an ATM device to the IBM 8285, you have to connect the physical cabling to the device and configure its ATM parameters. Then the device should be connected to the ATM network and you can check the status from the IBM 8285 console using SHOW PORT command.

Figure 45 on page 140 shows a sample console screen when the commands issued.

```
8285> show port 1.1 verbose [1]


     Type  Mode      Status
-------------------------------------------------------------------------------
 1.01:UNI enabled  UP-NO ACTIVITY [2]

Signalling Version   : with ILMI
Flow Control         : Off
VPI.VCI range        : 3.1023 (2.10 bits)
Connector            : RJ45
Media                : copper twisted pair
Remote device is inactive [2]
IX status            : IX KO [2]
Port speed           : 25600 kbps

8285>
8285> show port 1.1 verbose [3]


     Type  Mode      Status
-------------------------------------------------------------------------------
 1.01:UNI enabled  UP-OKAY [4]

Signalling Version   : with ILMI
Flow Control         : Off
VPI.VCI range        : 3.1023 (2.10 bits)
Connector            : RJ45
Media                : copper twisted pair
Remote device is active [4]
IX status            : IX OK [4]
Port speed           : 25600 Kbps

8285>
```

Figure 45. The Sample Console Screen to Check the Physical Connection

Notes:

1 This SHOW PORT command was issued when the physical cabling has been done but the remote device is power off.

2 You can get the status shown in several lines, but the main status is shown in the first line. The UP-NO ACTIVITY means the status physical cabling is done but no physical layer activity is detected.

3 This SHOW PORT command was issued when the physical connection was up and the remote device is been ready.

4 The UP-OKAY means the remote device is attached to the ATM network.

The typical reasons an ATM device might be unable to make a physical connection are as follows:

- **Cabling**

  If a fiber cable is used, check to see if the each end of the cable is connected to the appropriate connector, transmit or receive. And if a copper cable is used, check to see that the pinouts of the cable and each end of the cable are matched, especially when you use a non-Forum-compliant adapter or the connection is between ATM switches.

If the pinouts are mismatched, the status should be UP-NO ACTIVITY which means physical activity isn't detected on the port.

- **ATM Connection Parameters**

  Check if the ATM connection parameters used in the switch and the device are matched, such as:

  – Connection type (SVC/PVC)

  – VPC/VCC number

  – UNI Version (3.0/3.1/4.0)

  – Service type (CBR/VBR/UBR/ABR)

  – Required and available bandwidth if RB connection

  If this information is mismatched, the status should be UP-NOT IN SERVICE which means physical activity is detected on the port but that the device cannot access to the network.

7.2.4.2 Check the LANE Registration

When the physical layer connection is established, then the device requests to register with a LANE network. You can check the status from the IBM 8285 console using SHOW LAN_EMUL SERVERS and SHOW DEVICE commands.

Figure 46 and Figure 47 on page 142 show a sample console screen when the SHOW LAN_EMUL SERVERS command is issued.

```
8285> show lan_emul servers 1  1

-------------------------------------------------------------------------
--------------------------- LAN Emulation Server  1 ----------------------
Status                : Running.
LAN type              : Ethernet.
Actual ELAN name      : "IBM_ETHERNET_LAN1".
Desired ELAN name     : "".
Actual max frame size : 1516.
Desired max frame size: 1516.
ATM address : 39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.01.02
Max number of clients : 64.
Current number of operational clients : 3.  2
Local : 39.99.99.99.99.99.99.00.00.99.99.01.09
99.99.99.99.99.01.00 (port 0.0) OPERATIONAL NonProxy  3
00.20.35.34.20.87.81 (port 1.1) OPERATIONAL NonProxy  3
02.00.88.88.88.88.81 (port 1.8) OPERATIONAL NonProxy  3
8285>
```

Figure 46. The Sample Console Screen to Check the LANE Registration

Notes:

1 This SHOW LAN_EMUL SERVERS command was issued when the server was up and the clients have requested to be registered.

2 The number of clients registered with the IBM 8285 integrated LES are shown on this line.

3 The clients registered with the IBM 8285 integrated LES are shown in these lines. This information only appears when you specify either of the servers using the server ID.

```
8285> show device 1
8285 Nways ATM Workgroup Switch
Name : 8285
Location :


For assistance contact :


Manufacture id: 53-
Part Number: 58G9605 EC Level: C38846
Serial Number: LAG050
Boot EEPROM version: v.1.4.0
Flash EEPROM version: v.1.4.0
Flash EEPROM backup version: v.1.0.0
Last Restart : 14:57:56 Thu 17 Oct 96 (Restart Count: 1)

A-8285
------------------------------------------------------------------------
 ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.01.00

 > Subnet atm:
 IP address: 0.0.0.0. Subnet mask: 00.00.00.00

 > Subnet lan emulation ethernet/802.3 2
   Up 3
   Name :"IBM_ETHERNET_LAN1" 3
   MAC Address: 0200CCCCCCCC
   IP address : 9.100.86.200. Subnet mask: FF.FF.FF.C0
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.00
   Config LES addr:39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.02
   Actual LES addr:39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.02 3
   BUS ATM address:39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.02 3
   Config LECS add:none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 1. Maximum Transmission Unit: 1492 3
 > Subnet lan emulation token ring
   Not Started
   Name :""
   MAC Address: 000000000000
   IP address : 0.0.0.0. Subnet mask: 00.00.00.00
   ATM address    :39.99.99.99.99.99.99.00.00.99.99.01.09.99.99.99.99.99.00
   Config LES addr:none
   Actual LES addr:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   BUS ATM address:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Config LECS add:none
   Actual LECS add:00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   LEC Identifier: 0. Maximum Transmission Unit: 0

Default Gateway :
------------------------------------------------------------------------
 IP address: 0.0.0.0

ARP Server:
------------------------------------------------------------------------
 ATM address: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00

Dynamic RAM size is 8 MB. Migration: off. Diagnostics: enabled.

8285>
```

Figure 47. The Sample Console Screen to Check the LANE Registration

Notes:

1 This SHOW DEVICE command was issued when the server was up and the clients have requested to be registered. This command can be used to check the status of each LEC on the IBM 8285, especially if they are registered with an external LES.

2 This line shows the ELAN type and Ethernet type of the LEC. The ethernet/802.3 means the ELAN type is Ethernet and the Ethernet type is 802.3. Don′t make the mistake of thinking that ethernet/802.3 means that both DIX and 802.3 Ethernet types are supported. The LEC on the IBM 8285 can support either of them and the status should be ethernet/DIX when the Ethernet type is DIX.

3 The appropriate values in these fields means that the registration process has been successfully completed since these values are returned by the LES.

The typical reasons a LEC might be unable to register with the LES are as follows:

- **ATM switch connection**

  If the LECs are attached to a different switch, check to see if the connection between the switches has been established.

- **Designated LES address**

  Check if the designated LES ATM address specified for the LEC, especially the SEL field, is correct.

- **Max SDU size/ELAN name**

  Check if the same maximum SDU size and ELAN name are defined on the LEC and LES. If these values don′t match, the registration process fails. And some LECs, such as IBM 8285 internal LEC, don′t have specific values for itself, but instead gets the values from its LES.

- **Registration sequence**

  Reissue the LANE registration request from the LEC. Several devices have limited retry counts to issue the registration request and only do so during the initialization phase. Therefore, they won′t register when the LES is restarted. And the network or the LES congestion may prevent them from the successfully completing the registration process within the allowed period.

  For example, PCs using the IBM ATM device driver have retry count limit for the registration request but IBM 8281 and 8285 internal LECs do not.

7.2.4.3 Other Considerations

When the communication between LECs is unable to be established even though both LECs are registered with the LES, the typical reasons are as follows:

- **Ethernet type**

  Check to see if the same Ethernet type is configured for both LECs. For LECs to communicate with each other, they should be configured with the same Ethernet type, 802.3 or DIX/Ethernet V2.

  If one of the LECs that is unable to communicate is the IBM 8285′s, you can check the Ethernet type from the console using SET DEVICE command as shown in Figure 45 on page 140.

- **IP network number**

If one of the LECs that is unable to communicate is the IBM 8285′s, check to see if the IP interfaces, CIP, Ethernet LEC and token-ring LEC, have been defined with different subnetworks. If the IP interfaces are on the same subnetwork, only the CIP interface is used.

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Chapter 8. IBM 8285 Management

This chapter describes the SNMP-based management functions that are available with an IBM 8285 ATM network. It provides a brief overview of the MIBs that are available, functions of Nways Campus Manager ATM and an explanation of how to perform some of the functions that we have found useful in configurating and monitoring the IBM 8285 ATM network.

For more information about ATM campus network management, refer to the *ATM Campus Network Management*, SG24-5006.

8.1 Management Information Bases (MIBs)

The IBM 8285 control point provides full SNMP support with the use of standard SNMP commands, Get, GetNext, Set and Trap. Below is a list of all the MIBs an IBM 8285 ATM network supports that any SNMP-based management can use:

- **MIB-II (RFC 1213)**

  The IBM 8285 ATM subsystem fully supports this MIB described in RFC 1213, *Management Information Base for Network Management of TCP/IP-Based Internets: MIB-II*. For the purposes of the system group, ATM is treated as a data link protocol. The interface group describes the ATM cell layer interface. This group only concerns itself with the ATM cell layer as a whole and not the individual connections. Here the amount of traffic that was transmitted and received can be found. Also the number of cells dropped due to an incorrect HEC and invalid ATM cell header will be found.

- **IETF AtoM MIB (RFC 1695)**

  This MIB is described in RFC 1695, *Definitions of Managed Objects for ATM Management Version 8.0 using SMIv2* and also called AtoMIB. It describes objects used for managing ATM-based interfaces, devices, networks and services. The following are descriptions of the various groups:

  – The ATM Interface Configuration Group

    This group describes the type of ATM traffic on a particular interface. It contains ATM interface configuration parameters, such as the status of the interface, maximum number of VPCs and VCCs supported on an interface, the number of configured VPCs and VCCs, the number of active VPI and VCI bits, VPI/VCI of ILMI (if at all) and the ATM address type.

  – The DS3 PLCP Group

    This group has configuration and state information for those ATM interfaces that use DS3 for carrying ATM cells.

  – The ATM Traffic Descriptor Parameter Group

    This group has information relating the ATM traffic parameters, including the QoS class.

  – ATM Virtual Path Link (VPL) Group

    This group contains configuration and state information of a bi-directional VPL. Here VPs can be created, deleted or modified.

  – ATM Virtual Channel Link (VCL) Group

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This group contains configuration and state information of a bi-directional VCL. Here VCs can be created, deleted or modified here. Also, information can be found on the AAL that is in use on a VC specific information can be found if AAL5 is used, such as the type of data encapsulation.

- The Virtual Path (VP) Cross Connect Group

  This group contains configuration and state information of all point-to-point and point-to-multipoint VP cross connects. In other words, it gives information on the VP swapping table. With this group VP cross-connects can be established and removed.

- The Virtual Channel (VC) Cross Connect Group

  This group performs the same functions as in the VP cross connect group but for the VCs.

- The AAL5 Virtual Channel Connection Performance Statistics Group

  This group contains the AAL5 performance statistics of a VCC.

- **OSPF MIB**

  Since the TRS function uses OSPF with very few modifications to the original code, the IBM 8285 ATM network supports the OSPF MIB (RFC 1253) unchanged.

- **ILMI MIB**

  This MIB is defined by *The ATM Forum* in the UNI specification. Following is a brief description of the groups defined in these MIBs:

  - Physical Port Group

    This group gives information on a particular port such as the status, transmission types and cable type.

  - ATM Layer Group

    This group has the maximum number of supported VPs and VCs on the UNI, the number of VPs and VCs configured on the UNI and the number of active VP and VC bits on the interface.

  - ATM Statistics Group

    Here you will find the number of cells received, dropped and transmitted on the UNI.

  - Virtual Path Group

    This group gives information on the VPs on the UNI. This includes status, traffic shaping, policing and QoS parameters.

  - Virtual Channel Group

    This group performs the same functions as the virtual path group but for the VCs.

  - Network Prefix Group

    This group has information on the network prefix in use on the user side of the UNI and its validity.

  - Address Group

    This group has information on the ATM address in use on the user side of the UNI and its validity.

- **IBM Hub-Specific MIB Extensions**

  This MIB is an enterprise-specific MIB for the IBM Campus ATM Hubs. Following is a brief description of the groups defined in these MIBs:

  - Traps Control Group

    This group allows you to configure what traps are sent.

  - Switch Control Group

    This group determines which slots are controlled by the switch.

  - ATM Modules Group

    This group gives details on the modules, such as the maximum number of supported VPs and VCs, the number of VPs and VCs in use and the type of module.

  - ATM Port Group

    Information can be found here on the number of ports on a module, cable type, status and what interfaces it supports (UNI, NNI or SSI).

  - ATM Interface Group

    This group maps for each ATM port the MIB-II interface index and the physical slot/port numbers.

  - Cross Connect Group

    Information on the label swapping tables for VPs and VCs is stored here.

  - Neighbor Devices Group

    Here information can be found on the ATM devices connected on ports, such as the IP address and description.

  - TFTP Group

    This group controls the parameters for TFTP download functions.

  - Statistics Group

    Statistics for individual VP and VC connections are found here.

- **IBM Signalling Extensions**

  This IBM MIB extension defines ATM signalling support on the device. Below is a brief list of the information that can be accessed via this MIB:

  - Number of supported signalling channels
  - Range of reserved VPs and VCs
  - VPI/VCI used for the signalling channel on a port
  - The state of the Q2931 interface
  - Q2931 statistics, such as the number of call attempts and rejections
  - Information about Q2931 calls in progress, such as calling and called party
  - Details of cleared called including the ATM interface involved, calling and called party, date and time, cause of clearing, QoS requested and the bandwidth requested
  - Details and statistics on the SAAL

- **IBM PVC Management MIB Extensions**

- **IBM ATM Statistics MIB Extensions**

These IBM MIB extensions are fully listed in Appendix E, " IBM ATM Campus Switch Private MIBs" on page 195.

8.2 IBM Nways Campus Manager ATM Overview

This chapter describes an introduction to the Nways Campus Manager ATM.

This is a state-of-the-art network manager for ATM campus network. Nways Campus Manager ATM is a fully integrated package of network management applications for campus ATM networks. This application provides a complete ATM topology and management package for all ATM-capable IBM devices, such as ATM switches, ATM concentrators, and ATM bridges. This application is available on IBM and HP platforms.

Nways Campus Manager ATM provides management of IBM ATM subsystems and provides device management applications, also called product-specific modules (PSMs), for stand-alone or integrated (as an ATM module) IBM ATM hardware devices. Nways Campus Manager ATM provides device configuration and ATM network topology views that enable network administrators to quickly determine the status of the network and its components. Also, an ATM management function is included providing the capability to graphically display ATM connections on each user-device port (UNI port) of ATM switches. This feature allows network administrators to perform a visual connection tracking from one endpoint to another.

The Nways Campus Manager ATM is supported on the following platforms:

Nways Campus Manager ATM for AIX

This package implements three major components:

- The functionality sets from the former ATM Campus Manager for AIX:
  - ATM Network Topology Management
  - ATM Resource Configuration
  - ATM Fault Management
  - ATM Change Management
  - ATM Network Monitoring and Statistics Management
- The Management Application Transporter (MAT)
- ATM device management applications (PSMs)

Nways Campus Manager ATM for HP-UX

This is the HP-UX version of Nways Campus Manager ATM and is similar to it in terms of implementation and functionality.

Nways Manager for Windows

This is a simple, straightforward product, but with limited functions. It is best suited for small ATM networks, such as for the management of stand-alone ATM workgroup switches.

The main difference to the others are:

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- Very limited management function support for IBM 8260 ATM subsystem. For example, it does not recognize any ATM modules and can display only a few characteristics of these modules.
- Limited management function support for ATM logical resources. For example, it does not allow connection tracking.

8.3 IBM Nways Campus Manager ATM for AIX

The following sections describe the information about Nways Campus Manager ATM for AIX, especially for the IBM 8285 management.

8.3.1 Overview

Nway Campus Manager ATM for AIX, which is referred to as NCM-A in this book, is a program that runs under NetView for AIX. It combines the former ATM Campus Manager for AIX (ATMC) with the new PSMs. It allows seamless navigation between ATMC functions and graphic ATM device management applications. This package integrates ATM device management and the display of ATM connections that were not previously available on individual application products. For instance, the product-specific views of IBM ATM products, such as IBM 8285, 8281 and 8282, are shown in an ATM topology submap. It can be coupled with Nways Campus Manager LAN for AIX to provide management of the ATM modules in the IBM 8260 and of the legacy LANs via ATM bridge/routers. Coupling involves the topology integration used by each application.

Although Nways Campus Manager ATM is not mandatory to configure and set up an IBM 8285 ATM network, it is highly recommended because the information and functions that it provides will make it significantly easier to work with the ATM network.

The new version of Nways Campus Manager ATM V2, which provides some enhancements for IBM 8285 ATM network management, was announced in October 1996 and is now available in addition to V1.

8.3.1.1 Nways Campus Manager ATM V1 for AIX

Nways Campus Manager ATM V1 is composed of the following components:

- ATM Campus Manager Application

  ATM Campus Manager application is the functionality sets provided by the former ATM Campus Manager product. It provides a graphical user interface for controlling ATM resources, such as IBM 8285, 8260, 8281 and 8282. It allows you to manage your ATM environment from a single management station based on graphic views showing network topology views with easy-to-identify and color-coded icons.

- Management Application Transporter (MAT)

  MAT is shipped as a PTF for NetView for AIX and provides the framework to install and run product-specific modules (PSMs) to manage subsystems using device-specific functions.

- Product-specific modules (PSMs)

  A PSM allows you to have device-specific management by device-specific graphic views. PSMs are made based on object-oriented technology. The original PSMs are easy to transport different platform.

The functional highlights of Nways Campus Manager ATM V1 are as follows:

ATM Network Topology Management

The Nways Campus Manager ATM is fully integrated in the NetView for AIX or HP OpenView topology database. This means that it is possible to navigate from NetView for AIX or HP OpenView IP map to the ATM topology map using the protocol switching function. This reduces the time network operators need to perform their most current tasks and also gives status correlation among the following different domains:

- ATM Topology Map
- IP Topology Map, which means ATM IP nodes (correlated with ATM objects)
- Hub Expanded View, which comes with Nways Campus Manager LAN package. This means an IBM 8260 ATM node is correlated with a physical hub view from Nways Campus Manager LAN.

The following topology features are provided as well:

- Automatic discovery of ATM nodes and physical links between elements

  ATM nodes, such as IBM 8285, 8260, 8281 and 8282, are automatically discovered, placed in the submap and monitored. When the configuration of the network changes, the discovery capability indicates the changes and updates the corresponding network submap.

- Dynamic display of the topology hierarchy of ATM nodes and their operating status

  The graphical topology display uses a color code to represent the status of the following levels of resources displayed in submaps:

  - ATM Campus
  - ATM Clusters
  - ATM Nodes
  - ATM Interfaces

ATM Resource Configuration

The Nways Campus Manager ATM provides easy access to various submap levels allowing users to set and change the ATM switch and node configuration. The following resources can be configured or displayed:

- ATM physical resources, such as ATM interface ports
- PVC, including create, delete, set up and tear down (UNI)
- SVC, including tracking and forced clearing (UNI)
- VP and VC link

ATM Fault Management

The Nways Campus Manager ATM provides a complete set of messages, traps and event notifications. The integration of this information into NetView for AIX enables retrievability and more efficient problem determination. The user can customize the events in such a way to reduce the amount of information to manage large networks effectively.

The Nways Campus Manager ATM allows the recognition of network management information, which is described in 8.1, “Management Information Bases (MIBs)” on page 145, from different sources, supporting:

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- Display of traps
- Color coding of status information
- Logging of call failures

ATM Change Management

The Nways Campus Manager ATM provides a quick way to download code upgrades in the IBM ATM switches through the network (inband). Then it allows easy problem fixes or function enhancements on the IBM ATM switches that have the control point code.

ATM Network Monitoring and Statistics Management

The ATM Campus Manager application provides key performance counters.

Nways Campus Manager ATM allows you to collect statistical information and display it in a more readable graphical format. Below is a list of some of the different types of information that it can collect:

- Logging of calls

  All calls, that is calls in progress and calls that have been cleared, on a node can be logged with information, such as calling and called number, creation time, clear time and clear cause.

- Traffic

  Statistics on an interface′s traffic can be gathered with information, such as received and transmit cells, discarded cells and invalid cells.

- Bandwidth

  Information about the amount of bandwidth that is utilized on a port can be found.

- Q2931 Status

  Information on the incoming and outgoing calls in progress can be collected.

- SAAL Errors

  Information on the various errors detected by SAAL can be collected.

The data can be saved in a file as well. The availability of performance information from the Nways Campus Manager ATM enhances the ATM network by facilitating network tuning.

ATM Connection Tracking

Connections can be selected and tracked. The endpoints and all the intermediate nodes used by a connection can be graphically displayed.

Nways Campus Manager ATM allows you to perform the following connection tracking functions:

- List and delete SVCs
- Show the characteristics of SVCs, such as the calling and called party and QoS parameters
- List, delete and create PVCs
- Show the characteristics of a PVC
- Track the connection including the VPI/VCI labels of each segment of the connection and what physical ports the connection goes through

Product Specific Module (PSM) Support

The following PSMs are supported corresponding with MAT function:

- IBM 8224 Ethernet Stackable Hub
- IBM 8230 Token-Ring Concentrator (Model 003, 013, 213 04A,04P)
- IBM 8238 Token-Ring Stackable Hub
- IBM 8271 Nways Ethernet LAN Switch
- IBM 8272 Nways Token-Ring LAN Switch
- IBM 8281 ATM LAN Bridge
- IBM 8282 ATM Workgroup Concentrator
- IBM 8285 ATM Workgroup Switch (Base Unit)

8.3.1.2 IBM Nways Campus Manager ATM V2 for AIX

Nways Campus Manager ATM V2 provides the following functional enhancements in addition to V1:

- New PSMs support

  The PSMs (views) for the following devices are newly supported:

  - IBM 8210 MSS Server Release 1.5
  - IBM 8285 Expansion Unit
  - ATM 4-port 100 Mbps MIC or SC Fiber Module
  - ATM 12-Port 25 Mbps UTP Concentrator Module
  - ATM 2-Port 155 Mbps Flexible Media Module
  - ATM 4-Port TR/Ethernet Bridge Module
  - Utopia 1 ATM Carrier 1 or 2-slot Module

- PSM functional enhancements

  In addition to the new PSMs support, the following functional enhancements are provided to the PSM:

  - LAN Emulation trap support
  - Ability to display ATM-attached devices
  - Ability to backup and restore configuration
  - Ability to display SVCs
  - Ability to manage SVC log files

- New control point code support
- New ATM module support

  The following ATM modules (MIBs) are newly supported:

  - ATM 3-Port 155 Mbps LAN Concentration Module
  - ATM 4-Port TR/Ethernet Bridge Module
  - MSS Server Module Release 1.5

- LAN Emulation
  - Automatic discovery of LAN Emulation entities, such as servers, clients (proxy or non-proxy)

  - Dynamic display of LAN Emulation topology, such as administrative domains, ELANs, lists of clients and related servers
  - Configuration of LANE entities and services, such as domains, policies, LANE clients and servers
  - ELAN status reflected in an ATM device′s color state
  - ELAN fault management
  - ELAN security for preventing unauthorized station to connect a given ELAN group.
  - Central point for accessing servers error log (LECS/BUS/LES)
  - Drag and drop operations for add/remove/change on configuration
  - Use of templates to ease the ELAN management

    Templates are predefined automated scenarios that hide the complexity of each ELAN elementary configuration action. The user will be helped with pop-up windows in case of errors. Examples follow:

    - Create/remove ELANs to/from a domain
    - Move a client from an ELAN to another one
    - Administer/un-administer an ELAN

- Generic support of non-IBM (OEM) devices:
  - Automatic discovery of OEM devices (switches or edge devices)

    For example, the ATM uplink of any LAN switch or bridge will be managed.
  - Dynamic display of OEM devices with hook to specific management
  - Generic profile, such as configuration and fault management of OEM devices (standard SNMP MIBs)
- Automatic discovery enhancement

  The automatic discovery process can be relied on:
  - For the discovery of specific SNMP agents, such as OEM devices
  - To filter the devices that are discovered, based on their IP address or device type
  - To optimize polling by tuning its period for ATM devices
- Display of ATM workstations (node expanded view)
  - Automatic discovery of ATM workstations attached to IBM ATM switches when the station adapter supports ILMI MIB variables, such as the IP address and ATM address.
  - Generic profile, configuration and fault management of ATM standard-compliant workstations with SNMP agents.
- Command line interface

  Support of shell script-initiated commands for LANE.
- Global services
  - Save and restore IBM ATM switches configuration through single-slot configuration, using configuration files.

  - Global download of code updates for IBM ATM switches, bridges and concentrators; multiple selection list from EUI or flat file.

- Search facility

  Leverage of ObjectStore database used already by the Nways Campus Manager LAN:

  - Automatic search of ATM devices on miscellaneous criterion, such as IP address, ATM address, user name and ELAN name.
  - Same end user interface as Nways Campus Manager LAN.

8.3.2 Prerequisites

This section lists the recommended hardware and software requirements for the installation and operation of Nways Campus Manager ATM.

Hardware Requirements: ISC System/6000 POWERstations or POWERservers (minimum 50 MHz CPU) with the following options:

- An IBM compatible mouse
- Swap space twice the amount of RAM. For a machine with 96 MB of memory, for example, the recommendation is 192 MB of free disk space for paging space.
- A 256-color (8-bit plane) display device of at least 16 inches.
- A display/graphic card that supports 1280*1024*8 pixels resolution, which is set to this mode. If your display is configured for 1024*760*8 pixels, push buttons at the bottom of some panels may not be displayed.
- At least 96 MB of RAM, if you do not install LAN Network Manager.
- At least 128 MB of RAM, if you install LAN Network Manager. The exact amount of RAM depends on the size of the network you are managing and the number of other applications and X-stations you may be supporting.
- At most 280 MB of free disk space if all components are installed.

- For Router and Bridge Manager you require the following:
  - At least 60 MB of disk space for database files. Default location is /usr/rabmv2.
  - At least 30 MB of disk space for program files for the server. Location must be /usr/rabmv2.
  - At least 20 MB of disk space for program files for the client. Location must be /usr/rabmv2.
  - For the server, you must have at least 32 MB of free disk space in the /tmp file system for the ObjectStore cache. You can change the location of this cache by setting the OS_CACHE_DIR and OS_COMMSEG_DIR environment variables to another directory. Both variables must be set in the same directory.
  - For the client, you must have at least 16 MB of free disk space for in the /tmp file system for the ObjectStore cache. You can change the location of this cache by setting the OS_CACHE_DIR and OS_COMMSEG_DIR environment variables to another directory. Both variables must be set in the same directory.

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  - ObjectStore requires 8 MB of paging space beyond the paging space requirements of any existing applications.
  - One of the following to install the software:
    - 4mm tape drive
    - 8mm tape drive
    - 1/4-inch tape drive
    - CD-ROM drive

- A physical connection for running TCP/IP between IBM 8285 and Nways Campus Manager ATM station

  The requirements for the connection is as follows:

  - Either Nways Campus Manager ATM directly attaches an ATM network to the IBM 8285 or attaches a legacy LAN via an ATM bridge/router.
  - The following protocols are supported between the IBM 8285 and the ATM edge device, the Nways Campus Manager ATM workstation or the ATM bridge/router. The same protocol should be supported on both ends:
    - CIP (RFC1577)
    - Ethernet (DIX/Ethernet or IEEE 802.3) LAN Emulation (Forum-Compliant LAN Emulation V1.0)
    - Token-Ring LAN Emulation (Forum-Compliant LAN Emulation V1.0)

    Note

    As no Forum-Compliant LAN Emulation driver is currently available for the AIX environment, the Nways Campus Manager ATM station should attach a legacy LAN and have the connection via an ATM bridge/router that supports Forum-Compliant LAN Emulation when Forum-Compliant LAN Emulation is used.

Software Requirements:

- AIX V4.1.4 or AIX V4.2 for Campus Manager - ATM
- AIX V4.1.3, V4.1.4 or AIX V4.2 for Campus Manager - LAN and Router and Bridge Manager
- AIX Windows Environment/6000 V11R5

  In order to have drag and drop functions working properly under AIX V3.2.5, the PTF U442598 (x11rte.obj) and U441397 (x11rte.motif1.2) are required.
- OSF/Motif Version 1.2
- IBM SystemView NetView for AIX, V3R1, V4R1 Server, Client with latest PTFs, namely:
  - With NetView for AIX V3, PTF U444911 is required.
  - With NetView Server for AIX V4, PTF U444912 is required.
- ObjectStore 4.0.2 Runtime (shipped with Campus Manager Suite, Campus Manager - LAN, and Campus Manager - ATM packages) is required for:

  - 8250 and 8260/8285 Hub Manager
  - Router and Bridge Manager
  - Router and Bridge Manager
  - FDDI Application (LAN Network Manager)
  - LNM OS/2 Agent Application (LAN Network Manager)
  - SNMP Bridge Application (LAN Network Manager)
  - SNMP Token-Ring Application (LAN Network Manager)
  - ATM Manager and LAN Emulation Manager
- The following is required for Router and Bridge Manager:

  Mid-Level Manager Version 2.3 or higher. (Mid-Level Manager is shipped with the Campus Manager Suite and Campus Manager - LAN packages.)
  - For the server:
    - AIX V4.1.3, V4.1.4, or V4.2
    - NetView Version 4.1 server
  - For all clients:
    - AIX V4.1.3, V4.1.4, or V4.2
    - NetView Version 4.1 client
- DynaText Browser V2.3 or later (shipped with the Campus Manager Suite, Campus Manager - LAN, and Campus Manager - ATM packages).
- For PSMs, the additional prerequisite software you will need is:
  - Management Application Transporter (MAT) V2.1:
  - For NetView for AIX V3, PTF U444148
  - For NetView for AIX V4, PTF U444149

8.3.3 Using Nways Campus Manager ATM for AIX with IBM 8285

This chapter describes how to manage an IBM 8285 ATM network using Nways Campus Manager for AIX.

8.3.3.1 Submap Hierarchy

When you navigate through Nways Campus Manager ATM for AIX, you get the following submaps in a hierarchical level:

- Root submap
- ATM Campus submap
- Cluster submap

You can get ATM Switch View by double-clicking on an ATM switch on the cluster submap. And also, several panels are available for each switch, such as device view (PSM), profile and configuration management. The following sections provide brief explanations of each submap and view.

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8.3.3.2 Root Submap

The NetView for AIX Root submap shown in Figure 48 is the access point when using NCM-A.

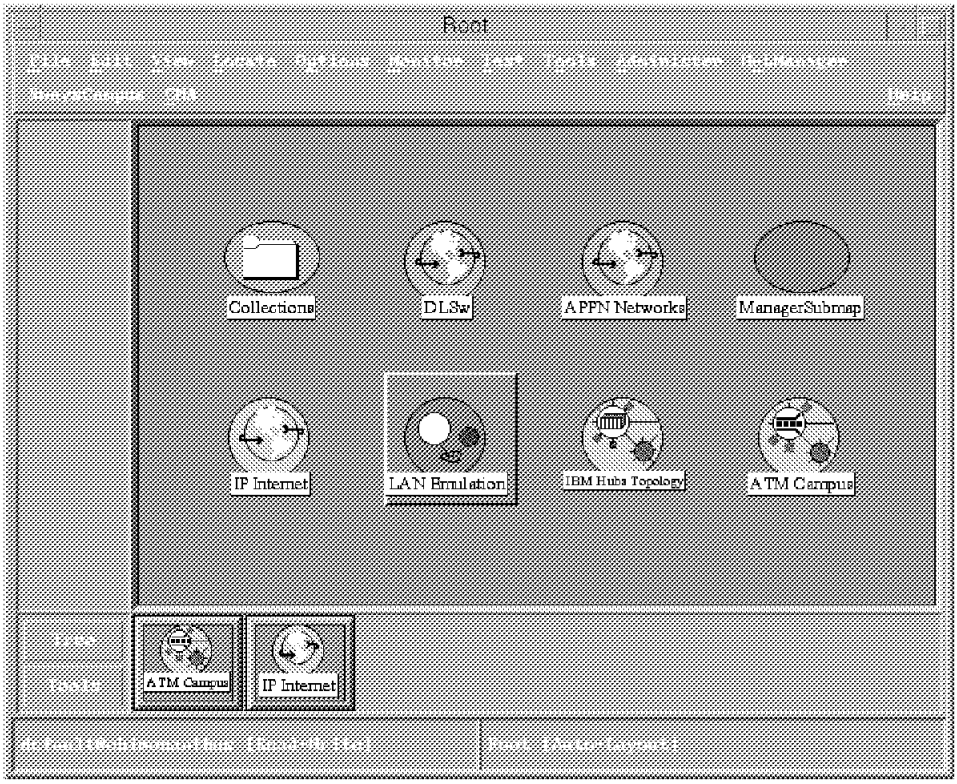

Figure 48. NetView for AIX Root Submap

From the Root submap you can:

- Manage the ATM Campus

  When the ATM campus is managed, each node of the ATM campus will be polled in the amount of time provided in the Polling Interval field.

- Unmanage the ATM Campus

  An unmanaged ATM campus is not managed by the NCM-A, meaning that none of nodes in this campus will be polled by the NCM-A.

- Explode the ATM Campus icon

  This allows you to display the ATM cluster level view in the ATM Campus submap.

8.3.3.3 ATM Campus Submap

The ATM Campus submap shown in Figure 49 on page 158 displays all the clusters in your ATM campus. From this submap you can choose to have a cluster managed or unmanaged by NCM-A.

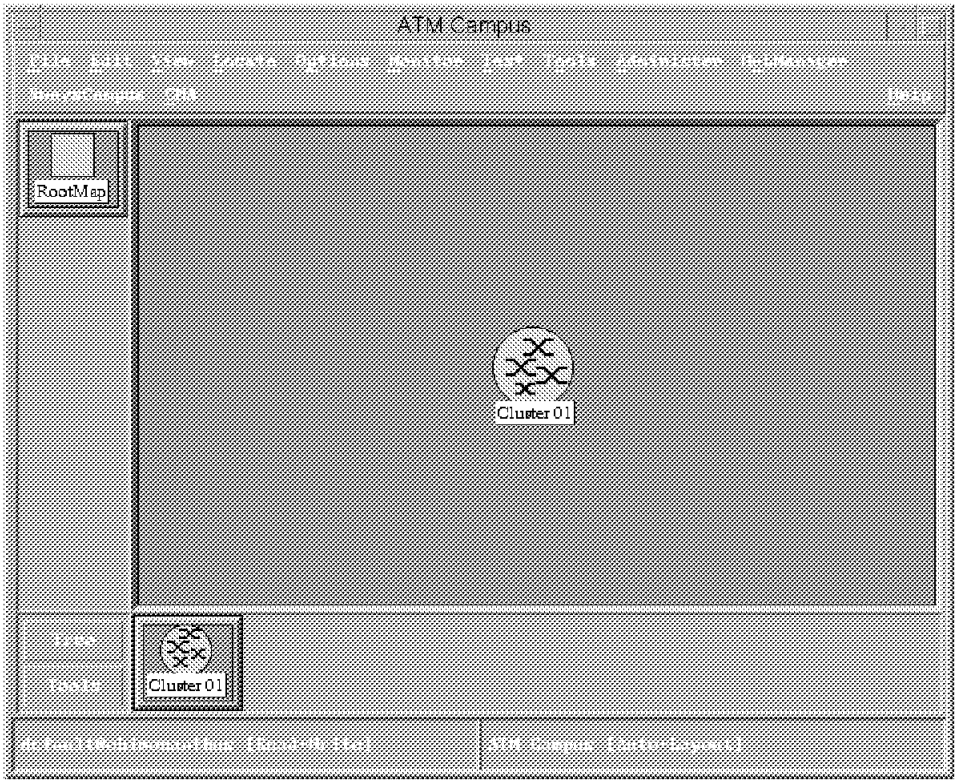

Figure 49. ATM Campus Submap

8.3.3.4 ATM Cluster Submap

The ATM Cluster submap shown in Figure 50 on page 159 displays the node-level view and contains the icons representing the IBM ATM switches and the ATM physical links between them.

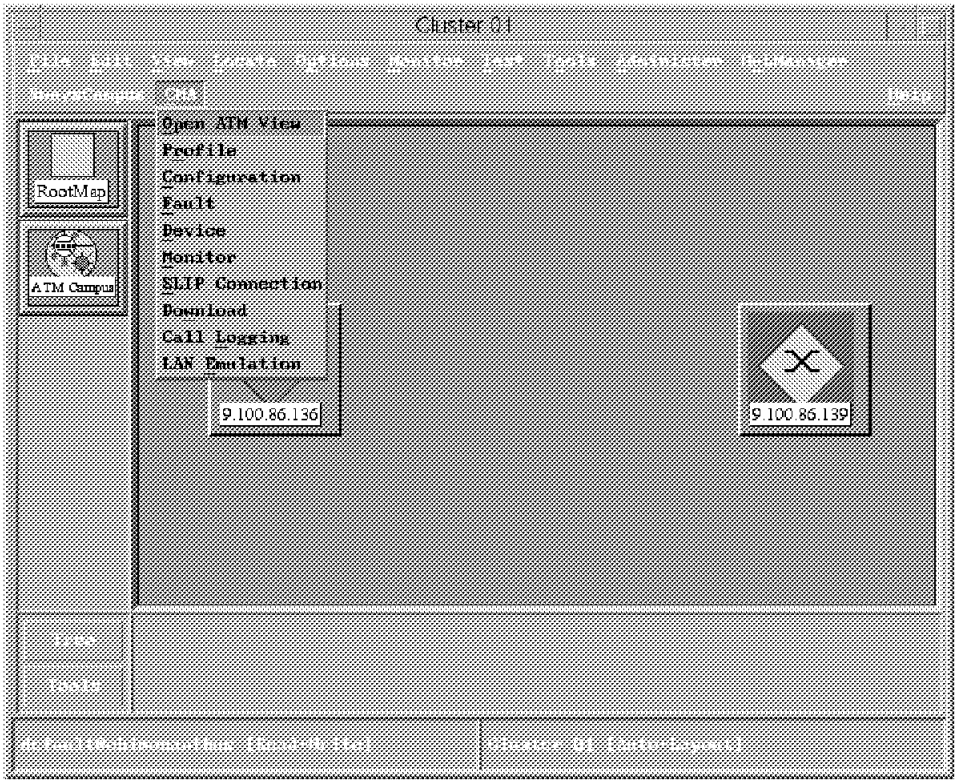

Figure 50. ATM Campus Submap

From this submap, you can manage or unmanage ATM switches. Also, from the pull-down list of CMA shown above, you can choose the following for each node:

- Open ATM View
- Profile
- Configuration
- Fault
- Device
- Monitor
- SLIP Configuration
- Download
- Call Logging
- LAN Emulation

These options are explained in 8.3.4, “IBM 8285 Node Related Information.”

8.3.4 IBM 8285 Node Related Information

The following sections describe the options for IBM 8285 node-related information.

8.3.4.1 8285 ATM View

The ATM View shown in Figure 51 allows you to display the interface-level view and contain icons representing the physical ATM ports of the IBM 8285 and the ATM node internal interface. The interface number shown for each port is slot(1 byte decimal)port(2 byte decimal). For example, the interface number for slot 3 port 1 is 301. This view replaces the ATM Node submap provided by the ATMC.

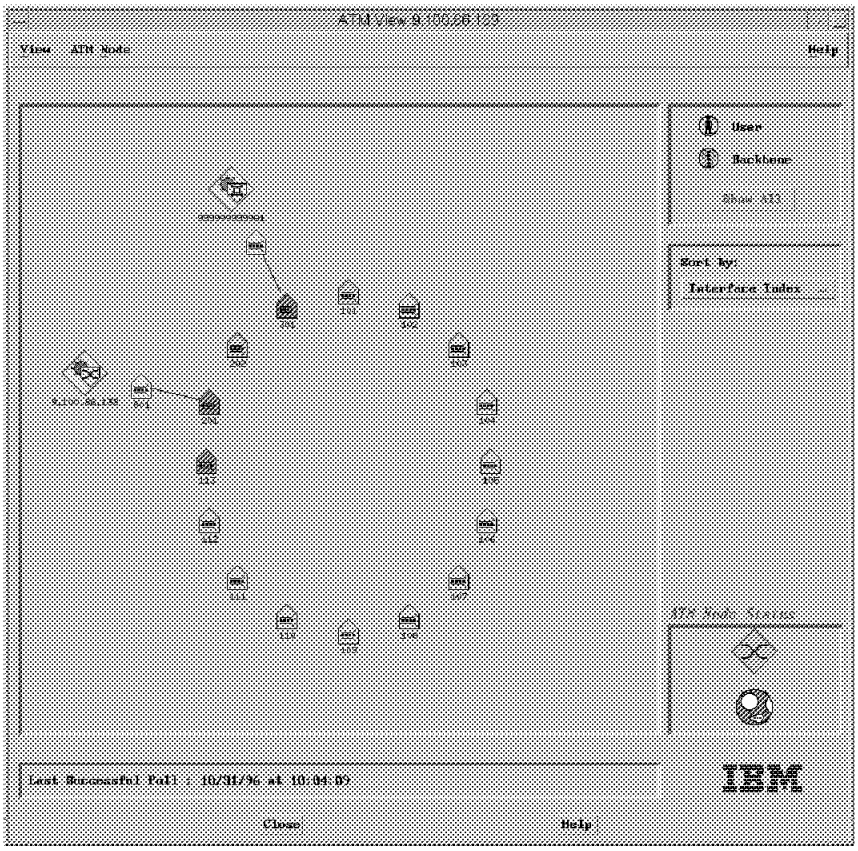

Figure 51. IBM 8285 ATM Node View - Star

You can choose the type of view from the following:

- Star
- Row/Column
- List

You can go to the other node management options described below by selecting an option from the pull-down list of ATM Node.

8.3.4.2 Profile

The profile panel shown in Figure 52 on page 161 allows you to modify the following:

- Contact Person
- Administratively-assigned Name
- Location

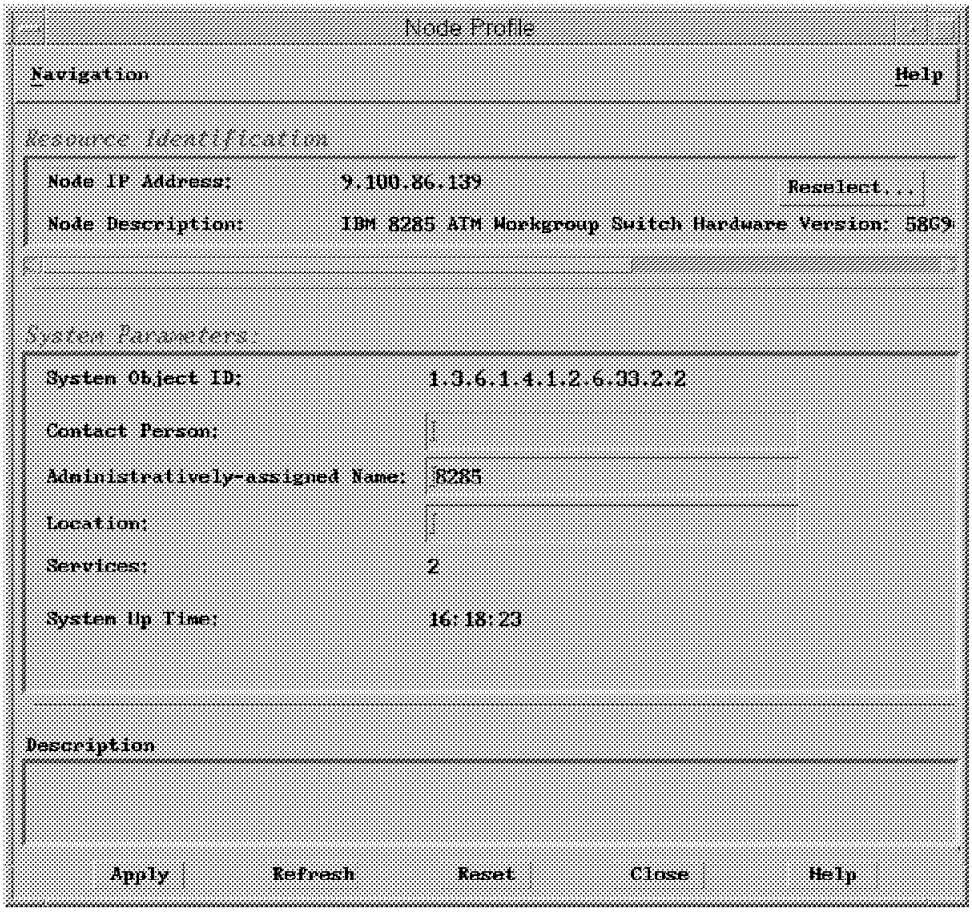

Figure 52. IBM 8285 Node Profile Panel

8.3.4.3 Configuration

The configuration panel shown in Figure 53 on page 162 can be used to:

- Display configuration information
- Lock and unlock selected ATM nodes

  This is done to ensure that the operator cannot unintentionally disable the port for exchanging network management information between the NCM-A and the switch.
- List the interfaces on the selected ATM node
- From the services option in the menu bar you can select any of two items:
  - File Transfer
  - Trace and Dump (System Trace, TRS Trace, System Dump, TRS Dump)

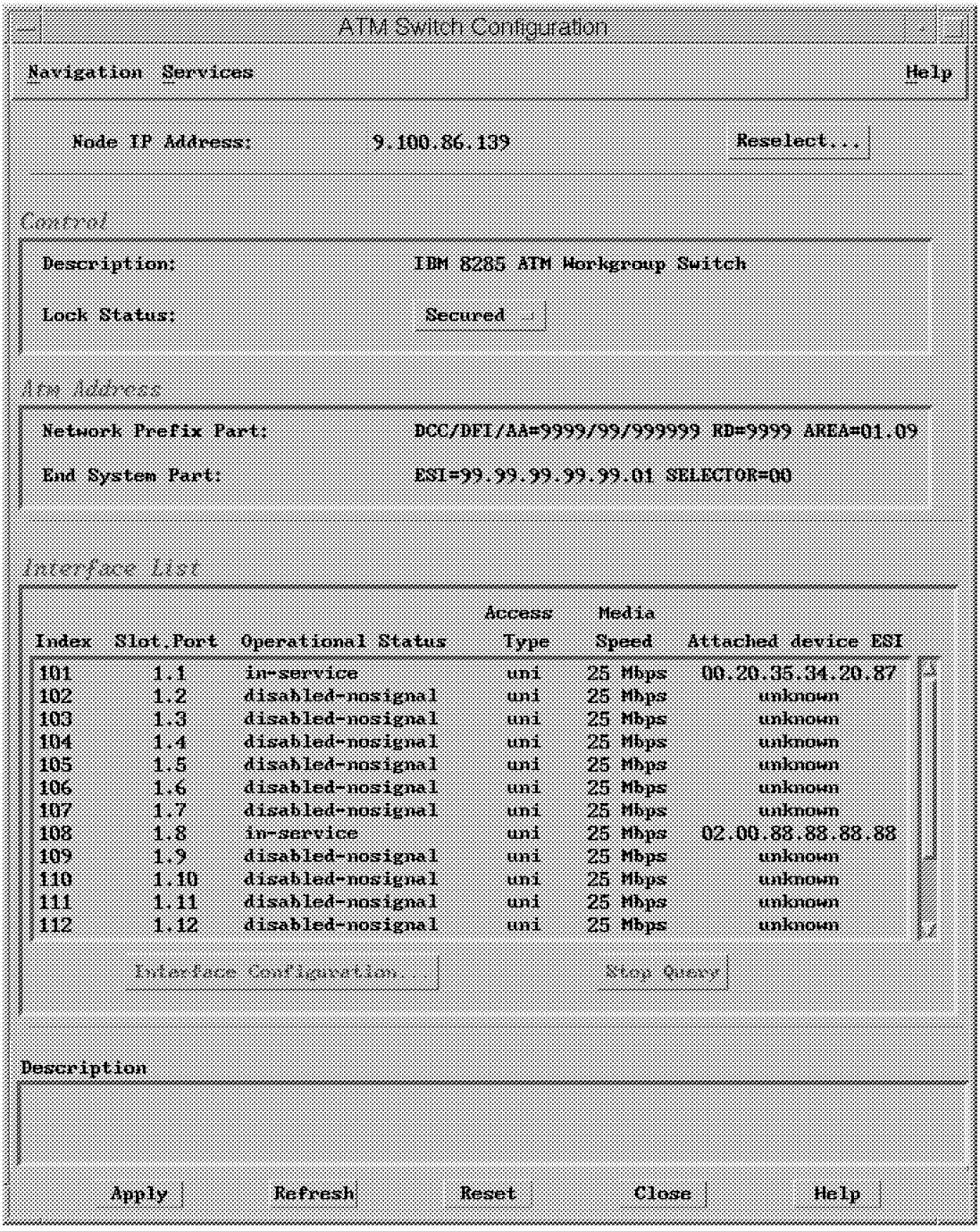

Figure 53. IBM 8285 Node Configuration Panel

8.3.4.4 Fault

The fault panel allows you to display the events received from the IP address of the selected IBM 8285.

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8.3.4.5 Device (8285 PSM)

The device view shown in Figure 54 allows you to display the physical graphic view (PSM) of the IBM 8285 and to manage the device and related parameters.

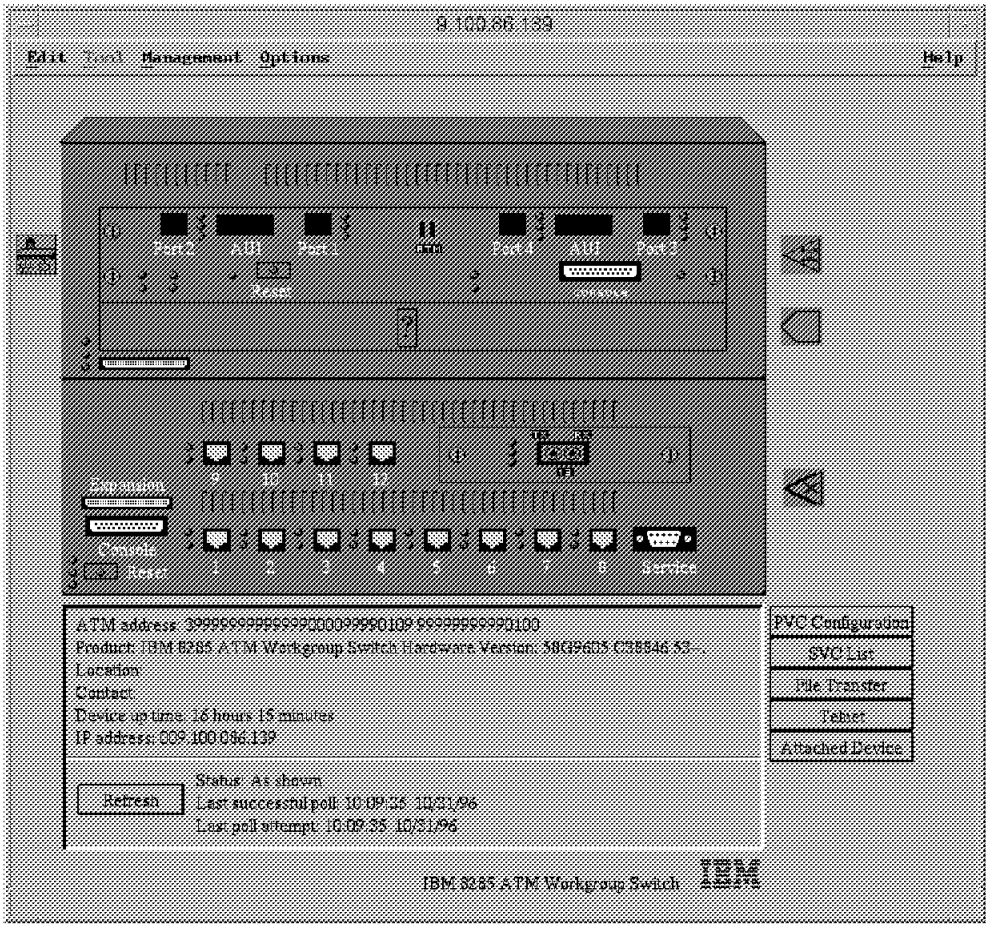

Figure 54. IBM 8285 Device View

The view above shows three menu items. The Tool entry is not used. The next screens are organized with the same main bullets as used by the PSM, and are presented as follows:

- Edit

  This allows you to modify/update the TCP/IP and SNMP general parameters used by the IBM 8285 device to communicate with the SNMP managers.

- Management

  This allows you to perform the actual IBM 8285 device management. The following sub-items are also presented:

  – Configuration

    This option allows you to perform IBM 8285 device configuration, such as IP configuration, microcode download, module configuration, and so on.

  – Performance

  – Fault

    This option allows you to set up traps to be sent to SNMP managers when a fault situation occurs.

  - Accounting

    This option allows you to display and modify the MIB-II system information parameters.

  - Security

    This option is not available for IBM 8285.

- Options

  This allows you to edit a memo file or controlling the polling rate to update the IBM 8285 graphic view.

The IBM 8285 device graphic view has some hot spots where you can single-click or double-click to obtain a more detailed information and/or access configuration panels. The following describes some of those areas on the view:

ATM Ports When you single-click on any port, the port is highlighted and the corresponding port configuration panel is displayed in the status area (the description box just below the IBM 8285 graphic view).

When you double-click on any port, the port configuration dialog appears. This dialog enables you to manage the selected port.

Console Port When you single-click on the console port, the port is highlighted, and the corresponding data is displayed in the status area.

When you double-click on the console port, the file transfer dialog panel appears for the IP address of the TFTP server and the path of the file name for the microcode module last downloaded to the managed device.

Reset When you double-click on the Reset button, the switch reset dialog box appears, enabling you to confirm the reset operation on the managed device.

Background surface of the managed device When you single-click on the background surface of the managed device graphic the data describing the managed device will be displayed.

When you double-click on the background surface of the managed device, the general information dialog panel appears and the general information data about the managed device is displayed.

Refresh Selecting the Refresh button initiates a poll to the subsystem. Once the poll is completed, it displays the current configuration and status of the subsystem.

PVC Configuration When you single-click on the PVC Configuration button, the PVC configuration panel appears. It allows you to display the PVCs currently defined to track the connection and to create a new PVC.

SVC List When you single-click on the SVC List button, the SVC list panel appears. It allows you to display the SVCs currently established to show the characteristics to track the connection and to delete.

File Transfer When you single-click on the File Transfer button, the file transfer panel appears. It allows you to use TFTP for the switch management, such as downloading the microcode and FPGA picocode from the management station to the switch.

Telnet When you single-click on the Telnet button, the management station establishes a telnet connection to the switch and provides you the console interface.

Attached Device When you single-click on the Attached Device button, the attached device panel appears. It allows you to display the ATM devices attached to the switch.

The color of a port on the managed device is a visual indication of its status and has the following meaning:

Red The port is disabled.

Yellow The port is enabled but not connected.

Gray The port is administratively disabled.

Blue The port state is unknown.

Green The port is enabled and in service.

The color of the console port indicates the status of the last file transfer and has the following meaning:

Red Transfer failed.

Blue Download status unknown.

Green No transfer since startup, transfer in progress, or transfer successfully completed.

A blue border around the managed device graphic means that the device is not responding or that communication to the device has encountered problems. The status and configuration information presented on the subsystem window represents the status before communication to the device was lost.

8.3.4.6 Monitor

The ATM monitor panel allows you to display an overview of the traffic rate going through the selected ATM subsystem.

8.3.4.7 SLIP Configuration

The SLIP Configuration panel allows you to add/modify SLIP configuration communicating with the switch.

8.3.4.8 Download

The Download panel allows you to download the microcode and FPGA picocode to the switch.

8.3.4.9 Call Logging

The call logging panel shown in Figure 55 on page 166 provides you to display the call log information corresponding to the IBM 8285 ports.

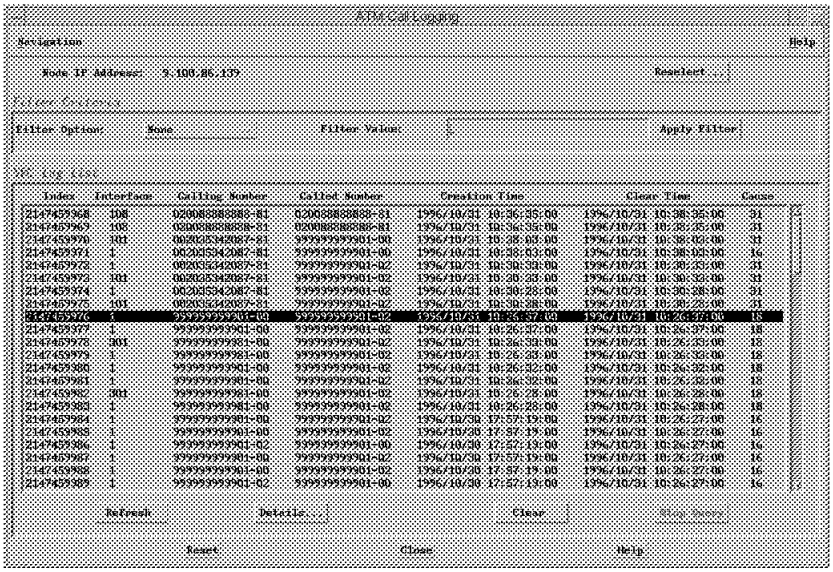

Figure 55. IBM 8285 Node Call Logging Panel

8.3.4.10 LAN Emulation

The LAN Emulation panel shown in Figure 56 displays the LANE components information corresponding to the IBM 8285 ports, such as the integrated LES/BUS, internal LEC and external LECS.

Figure 56. IBM 8285 Node LAN Emulation Panel

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Figure 57 on page 167 displays the new LAN Emulation application.

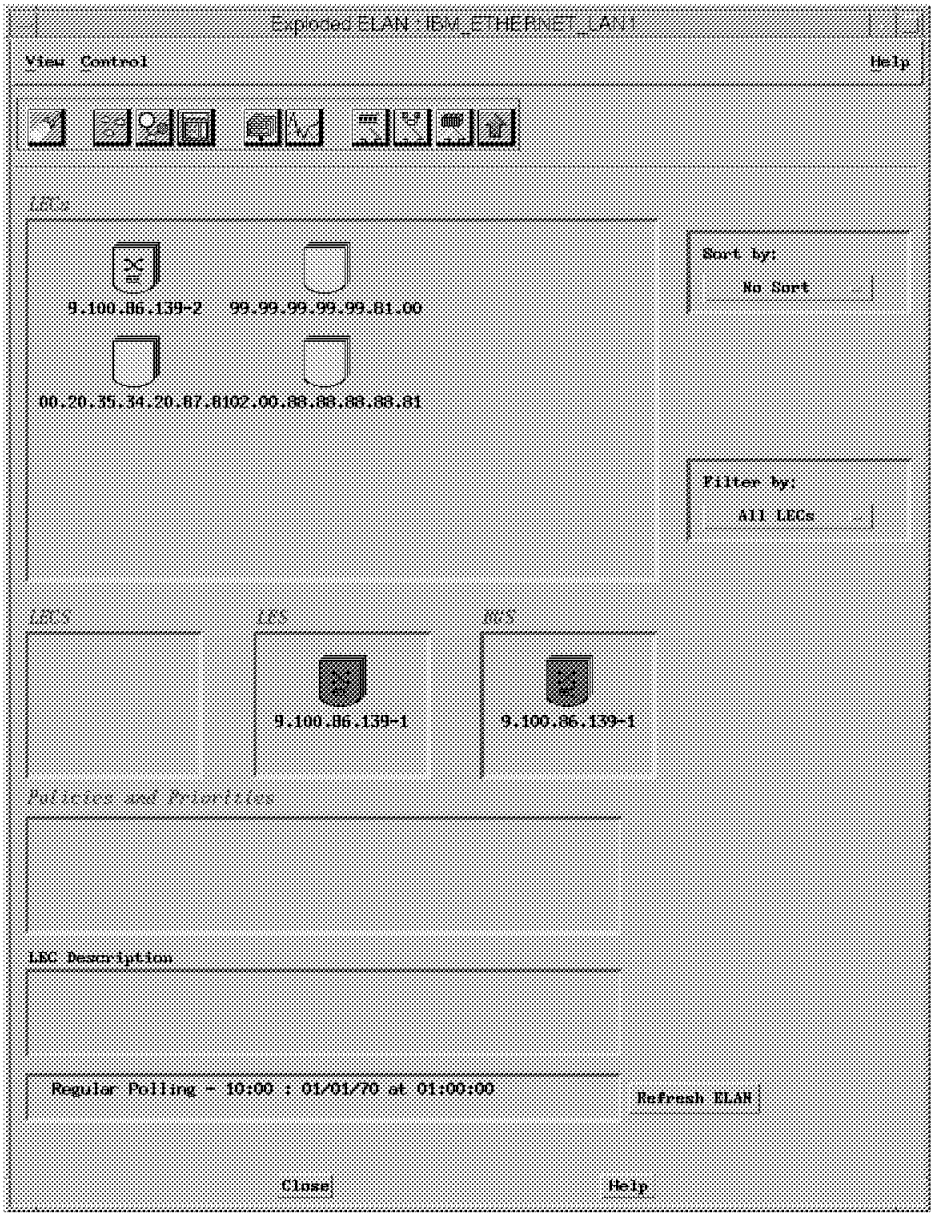

Figure 57. ELAN View

8.4 Nways Manager for Windows

The following sections describe the information about Nways Manager for Windows, especially for the IBM 8285 management.

8.4.1 Overview

Nways Manager for Windows provides a low-cost, easy-to-use network management solution that allows you to proactively manage your campus network.

As described above, Nways Manager for Windows provides very limited functions compared with Nways Campus Manager ATM for AIX to manage an ATM network but would be a good solution for management of stand-alone ATM workgroup switches.

The new version of Nways Manager for Windows, V2, which supports IBM 8285, was announced in October 1996 and is now available in addition to V1.

8.4.1.1 Nways Manager for Windows V1

The Nways Manager for Windows V1 is a competitively priced integrated suite of network management applications that work seamlessly with the IBM NetView for Windows management platform to remotely control and monitor the following networking devices:

- IBM 8224 Ethernet Stackable Hub
- IBM 8230 Token-Ring Concentrator (Models 003, 013, 213, 04A, 04P)
- IBM 8271 Ethernet LAN Switch Model 001
- IBM TURBOWAYS 8282 ATM Workgroup Concentrator
- IBM 8281 ATM LAN Bridge
- IBM 8250 Multiprotocol Intelligent Hub
- IBM 6611 Network Processor
- IBM 2210 Nways Multiprotocol Router

The Nways Manager for Windows program provides integrated and easy-to-use graphical interfaces for configuration, fault, and performance management solution for networks and can be used to manage a variety of SNMP managed devices in addition to those above mentioned.

The suite is packaged with NetView for Windows V2 at a competitive price.

Nways Manager for Windows has been enhanced via PTF UR44773 to support the following IBM networking devices:

- IBM 8238 Nways Token-Ring Stackable Hub
- IBM 8271 Ethernet LAN Switch Models 108
- IBM 8260 Multiprotocol Intelligent Switching Hub

8.4.1.2 Nways Manager for Windows V2

Nways Manager for Windows V2 is packaged with the NEWT TCP/IP stack and NetView for Windows as well as V1 but the versions are the latest (NEWT V4.6 and NetView for Window V2.1).

Nways Manager for Windows V2 provides the following functional enhancements in addition to V1:

- New PSMs Support

  The PSMs for the following devices are newly supported:

  - IBM 8210 Multiprotocol Switched Services Server
  - IBM 8225 Fast Ethernet Stackable Hub
  - IBM 8230 Token-Ring Concentrator Model 04x RI/RO Module

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  - IBM 8235 DIALS Server (Models 001, 002, 011, 012, 021, 022, 031, 032, 051, 052)
  - IBM 8250 Multiprotocol Intelligent Hub feature:
    - 8250 Token-Ring 18-port Active Media Module
  - IBM 8260 Multiprotocol Intelligent Switching Hub features:
    - 8250 Token-Ring 18-port Active Media Module
    - Ethernet Flexible Concentration Module
    - ATM Control Point Switch Module
    - 4-port 100 Mbps ATM Concentration Module
    - 12-port 25 Mbps ATM Concentration Module
    - 2-port 155 Mbps ATMFlex Concentration Module
  - IBM 8271 Nways Ethernet LAN Switch Model 216
  - IBM 8272 Nways Ethernet LAN Switch Model 216
  - IBM 8285 Nways ATM Workgroup Switch features:
    - 8285 Expansion Unit
    - 8285 Base Unit 155 Mbps SMF I/O Card
    - ATM 4-port 100 Mbps MIC or SC Fiber Module
    - ATM 12-Port 25 Mbps UTP Concentrator Module
    - ATM 2-Port 155 Mbps Flexible Media Module
    - ATM 4-Port TR/Ethernet Bridge Module
    - Utopia 1 ATM Carrier 1 or 2-slot Modules

- IBM 8285 Configuration Options

  PSMs for IBM 8285 also supports the following configuration options associated with above modules, but will not display the module in the IBM 8285 graphic.

  - LAN Emulation Trap Support
  - Ability to display ATM attached devices
  - Ability to backup and restore a configuration
  - Ability to display SVCs
  - Ability to manage SVC log files
  - Ability to telnet into the 8285

- RMON Coupling

  IBM Nways RMON for Windows V1 is offered as a separate product that seamlessly integrates with Nways Manager for Windows through the use of its RMON PSM.

8.4.2 Prerequisites

This section lists the recommended hardware and software requirements for the installation and operation of Nways Manager for Windows.

Hardware Requirements:

- Minimum 80486 DX processor at a minimum 33 MHz
- SVGA high-resolution workstation monitor support

  An SVGA adapter is required only if SVGA support is not built into the motherboard.
- 16 MB RAM (24 MB for large networks)
- 156 MB free hard disk (240 MB recommended) which includes:
  - 8 MB free hard disk for NETMANAGE NEWT V4.6
  - 125 MB free hard disk for NetView for Windows V2.1
  - 25 MB free hard disk for Nways Manager for Windows V2 and 14 MB for V1
- Network interface card with NDIS or ODI support
- CD-ROM drive
- 3.5-inch diskette drive
- Mouse supported by Microsoft Windows

Software Requirements:

- DOS 5.0 or later
- MIcrosoft Windows 3.1 or later
- NDIS or ODI device driver for the Network interface card

8.4.3 Using Nways Manager for Windows with IBM 8285

Please refer to *Campus ATM Network Management Guidelines*, SG24-5006 for network management using the latest software.

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Appendix A. 8285 ATM Control Point Commands

This appendix describes the various functions and features that are supported by the 8285 Control Point.

A.1 Command Line Interface

To be able to configure and manage the 8285 and the ATM media modules installed in the expansion unit, the 8285 provides a command line interface that can be accessed via an ASCII terminal connected locally (or via a modem) to the RS-232 port on the front panel of the module.

The command line interface allows you to configure and display the status of the various components of the 8285 ATM switch system. Additionally it allows you to maintain the various software components of the 8285 by downloading new levels of microcode for these components. Finally, the command line interface provides you with the ability to collect traces and dumps of the various components in the event of problems that may occur in the ATM switching subsystem.

A.1.1 How to Access the Command Line Interface

To be able to access the command line interface, you need to connect an ASCII terminal (VT100 or compatible) to the RS-232 port on the 8285 base unit. This connection can be either a local connection or through a telecommunication line using a pair of modems. In the 8285 shipping group, you will find an attachment cable with adapters to be used for connecting the ASCII terminal to the RS-232 port. You must ensure that the ASCII terminal is configured according to the following factory default settings for the RS-232:

- 9600 baud
- 8 data bits
- No parity
- 1 stop bit

These settings can be changed once a terminal with the previous configuration is connected. The process of how to change these settings is discussed in A.1.5, “How to Change Terminal Settings” on page 174.

The command line interface has the following characteristics:

- The commands are not case-sensitive. The system interprets ABC (uppercase) the same as abc (lowercase).
- The 8285 command line accepts abbreviated command input, which enables you to enter a command by typing the minimum number of characters (that uniquely identifies the command) followed by the space bar. Pressing the space bar automatically fills the rest of the command.
- The system prompts you if you forget to enter a mandatory command.
- To get help, simply type ? on the command line. Also, when entering a command you get the system to display the next available options by entering ?.

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- All the commands can be abnormally terminated by pressing the Ctrl and C keys simultaneously.

The following table is a quick reference to the procedures required to configure the ATM subsystem of the 8285. Some of them are mandatory; others are recommended.

Table 37. 8285 Configurations SET Commands Quick Reference List

Procedure	**8285 Commands**
Configure user and administrator passwords	SET DEVICE PASSWORD
Configure 8285 terminal settings	SET TERMINAL BAUD SET TERMINAL DATA_BITS SET TERMINAL PARITY SET TERMINAL STOP_BITS SET TERMINAL PROMPT SET TERMINAL TIME_OUT SET TERMINAL HANGUP SET TERMINAL CONSOLE_PORT_PROTOCOL
Configure 8285 device configuration	SET CLOCK SET DEVICE NAME SET DEVICE LOCATION SET DEVICE CONTACT SET DEVICE DIAGNOSTICS
Configure 8285 ATM address	SET DEVICE ATM_ADDRESS
Configure Classical IP parameters for 8285	SET DEVICE IP_ADDRESS SET DEVICE DEFAULT_GATEWAY SET DEVICE ARP_SERVER
Configure LEC IP parameters for 8285	SET DEVICE LAN_EMULATION_CLIENT
Configure SLIP parameters for 8285	SET TERMINAL CONSOLE_PORT_PROTOCOL SET TERMINAL SLIP_ADDRESS SET TERMINAL BAUD
Configure LE server parameters (LECS and LES/BUS) for 8285	SET LAN_EMUL CONFIGURATION_SERVER SET LAN_EMUL SERVER
Configure SNMP parameters for 8285	SET COMMUNITY SET ALERT
Configure ATM media modules	SET MODULE
Configure ATM ports	SET PORT
Configure NNI connection between Hubs	SET LOGICAL_LINK
Configure NNI connections ATM subnetworks	SET STATIC_ROUTE
Configure ESI for ATM stations	SET ATM_ESI
Configure PVCs and PVPs	SET PVC
Configure TFTP parameters for download/upload	SET TFTP FILE_NAME SET TFTP FILE_TYPE SET TFTP SERVER_IP_ADDRESS SET TFTP TARGET_MODULE
Configure trace/dump facilities	SET TRACE

A.1.2 Access Mode

There are three levels of access mode to 8285 via the console port:

- **User Mode**

  When you are logged on as a user, you have access to some 8285 commands with read-only access. This allows you to view ATM subsystem status, get help, clear counters, and log off. The factory default user password is `a null string`.

- **Administrator Mode**

  When you are logged on as administrator, you have access to all the 8285 commands with read-write access, which allows you to display and modify the ATM switching subsystem in the 8285. The factory default administrator password is 8285.

- **Maintenance Mode**

  When you are logged on as administrator and enter the `MAINTAIN` command in administrator mode, you have access to maintenance functions, such as downloading out-of-band and clearing the ATM subsystem configuration. No password is required to access the maintenance mode from the administrator mode. To quit the maintenance mode, you have to enter the BOOT command to reset the ATM subsystem.

  Note

  You can access the maintenance mode only if you logged on with the administrator password from a local ATM control point session via the RS-232 port. You cannot access the maintenance mode from a remote session started with the TELNET command.

There are no user IDs associated with these modes. Once you connect to the 8285, you will be prompted to enter a password. The password that you enter determines if you get administrator or user.

A.1.3 How to Change Administrator and User Password

After logging in to 8285 for the first time, you are strongly advised to change the default password for the administrator, so you can prevent unauthorized users from being able to log on to the 8285 to view or modify your ATM network configuration.

Figure 58 shows how you can change the administrator password. For security purposes, the values you enter are not displayed on the screen.

```
8285> set device password administrator
Enter current administrator password:
New password:
Re-enter password:
Password changed.
8285>
```

Figure 58. Changing Administrator Password

Note

8285 passwords are case-sensitive.

You can also change the user password. Figure 59 shows an example of how it is changed.

```
8285> set device password user
Enter current administrator password:
New password:
Re-enter password:
Password changed.
8285>
```

Figure 59. Changing User Password

A.1.4 Resetting the Password to Factory Default

If you forget the administrator password for the 8285, you can use the following procedure to reset the password to the factory default:

1. Enter FORCE at the password prompt.
2. Select the **ATM Reset** button on the 8285 front panel.

A.1.5 How to Change Terminal Settings

You can customize the terminal settings of the 8285 if you are logged on as administrator. The following commands are provided:

- **Set Terminal Baud**

  This command allows you to set the baud rate at which the 8285 will communicate with the attached console or modem. The following example shows you how to change the baud rate to 2400 bps:

```
8285> set terminal baud 2400
```

Figure 60. Changing the Terminal Baud Rate

- **Set Terminal Data_Bits**

  This command lets you configure the 8285 to the number of data bits used by the attached console. For example, the following command allows you to change the number of data bits to 7:

```
8285> set terminal data_bits 7
```

Figure 61. Changing the Terminal Data Bits

- **Set Terminal Parity**

  This command lets you configure the 8285to the same parity used by the attached console. The following example shows you how to change the parity bit to even:

```
8285> set terminal parity even
```

Figure 62. Changing the Terminal Parity

Note

When you change the settings for the baud, data_bits, or parity parameters, a mismatch will result between your ASCII terminal and the 8285. This mismatch will result in you not being able to access the 8285 until you change the configuration of your terminal.

- **Set Terminal Stop_Bits**

  This command allows you to configure the 8285 to the number of stop bits used by the attached console or modem. The following example shows you how to change the number of stop bits to 2:

```
8285> set terminal stop_bits 2
```

Figure 63. Changing the Terminal Stop Bits

- **Set Terminal Prompt**

  This command allows you to customize the prompt that is displayed when you are connected to the 8285. An example of this this command and the result is shown in Figure 64:

```
8285> set terminal prompt ATMWKGP>
ATMWKGP>
```

Figure 64. Changing the Terminal Prompt

  This command is useful for identifying the 8285 to which you are connected. The factory default prompt is 8285>. It is recommended that you set the prompt to the device name you specify for the 8285. Refer to the SET DEVICE NAME command to show how to configure the 8285 device name. This will help you to identify the 8285 to which you are connected when using Telnet.

- **Set Terminal Hangup**

  This command allows you to configure 8285 to automatically disconnect the modem (drop DTR) when you log off. To do so, you must issue the following command:

```
8285> set terminal hangup disable
```

Figure 65. Disabling the Terminal Auto Hangup

  The default is disable, which means that the modem will not hang up, and an unauthorized user may pick up your 8285 modem session.

- **Set Terminal Time_Out**

  This command allows you to set the number of minutes that you can remain logged on to an 8285 session without keyboard activity. This is a security

measure that prevents unauthorized users from accessing and working in an open 8285 session when the 8285 console is left unattended. The default value is 0, which means that the terminal will never time out. An example of this command is as follows:

```
8285> set terminal time_out 10
```

Figure 66. Changing the Terminal Timeout

The value previously specified is in minutes and can go up to 30.

After setting all the parameters for the terminal, you must ensure that you save them using the following command:

```
8285> save terminal
```

Figure 67. Saving the Terminal Settings

You can display the current settings for the terminal using the following command:

```
8285> show terminal
```

Figure 68. Showing the Terminal Settings

An example of the output you could get is shown in Figure 69.

```
Terminal Parameters:
Baud         9600
Data bits    8
Hangup       DISABLE
Parity       NONE
Stop bits    1
Timeout time 0
8285>
```

Figure 69. Output from Show Terminal Command

A.2 IBM 8285 ATM Command List

Table 38 on page 177 shows the list of ATM commands supported by the IBM 8285. For more information about the commands, refer to the *IBM 8260 Nways Multiprotocol Switching Hub IBM 8285 Nways ATM Workgroup Switch ATM Command Reference Guide*, SA33-0385 and the release note for ATM switch microcode you are using. The release note includes the latest information not described in the manual.

Table 38 (Page 1 of 2). IBM 8285 Nways ATM Workgroup Switch ATM Command List

Command	Access Mode	Comments
?	User	Displays all available commands/parameters for next entering
BOOT	Maintenance	
CLEAR ALL	Maintenance	
CLEAR ATM_ESI	Administrator	
CLEAR COMMUNITY	Administrator	
CLEAR CONFIGURATION	Maintenance	
CLEAR ERROR_LOG	Administrator	
CLEAR LAN_EMUL CONFIGURATION_SERVER	Administrator	
CLEAR LOGICAL_LINK	Administrator	
CLEAR PVC	Administrator	
CLEAR STATIC_ROUTE	Administrator	
DOWNLOAD INBAND	Administrator	
DOWNLOAD OUT_OF_BAND	Maintenance	
DUMP TRS	Administrator	
LOGOUT	User	
MAINTAIN	Administrator	
PING	User	
RESET ATM_SUBSYSTEM	Administrator	
RESET MODULE	Administrator	For the module installed in the expansion unit
REVERT	Administrator	
SAVE	Administrator	
SET ALERT	Administrator	
SET ATM_ESI	Administrator	
SET CLOCK	Administrator	
SET COMMUNITY	Administrator	
SET DEVICE	Administrator	
SET LAN_EMUL CONFIGURATION_SERVER	Administrator	
SET LAN_EMUL SERVER	Administrator	
SET LOGICAL_LINK	Administrator	
SET MODULE	Administrator	
SET PORT	Administrator	
SET PVC	Administrator	
SET STATIC_ROUTE	Administrator	
SET TERMINAL	Administrator	
SET TFTP FILE_NAME	Administrator	
SET TFTP FILE_TYPE	Administrator	
SET TFTP SERVER_IP_ADDRESS	Administrator	

Table 38 (Page 2 of 2). IBM 8285 Nways ATM Workgroup Switch ATM Command List

Command	Access Mode	Comments
SET TFTP TARGET_MODULE	Administrator	
SET TRACE	Administrator	
SHOW ALERT	User	
SHOW ATM_ESI	User	
SHOW CLOCK	User	
SHOW COMMUNITY	User	
SHOW DEVICE	User	
SHOW ERRORS	Maintenance	
SHOW FLASH	Maintenance	
SHOW LAN_EMUL CONFIGURATION_SERVER	User	
SHOW LAN_EMUL SERVERS	User	
SHOW LOGICAL_LINK	User	
SHOW MODULE	User	
SHOW PORT	User	
SHOW PVC	User	
SHOW STATIC_ROUTE	User	
SHOW TERMINAL	User	
SHOW TFTP	User	
SHOW TRACE	Administrator	
SWAP ACTIVE	Maintenance	
SWAP FPGA_PICOCODE	Administrator	
SWAP MICROCODE	Administrator	
TELNET	User	
UPLOAD	Administrator	
USER BAUD	Maintenance	
WRAP	Administrator	

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Appendix B. Pinouts for Ports and Cables

This appendix gives information on ports and cables PIN assignments.

B.1 Pinouts for ATM25 and Other Common Network Connectors

Most networking standards have developed specifications for using shielded or unshielded twisted-pair cabling with RJ-45 modular plugs to connect devices together. Table 39 illustrates the differences between the following cabling specifications:

- ATM25.6 (ATM Forum Standard)

  IBM adapters for this standard have an orange dot with a white line across it to easily distinguish from the next two types.

- ATM25.6 (Pre-Standard--Used by some early ATM devices)

  This adapter has a green dot on it indicating that it uses standard token-ring pinouts.

- Token-Ring

  This adapter has a green dot on it indicating that it uses standard token-ring pinouts.

- Ethernet (10Base-T)

Table 39. RJ-45 Pin Assignments by Network Type

Pin Number	ATM25 (Forum-Compliant)	ATM25 (Pre-Standard)	Token Ring	Ethernet (10Base-T)
1	RD+			TD+
2	RD–			TD–
3		TD+	TD+	RD+
4		RD+	RD+	
5		RD–	RD–	
6		TD–	TD–	RD–
7	TD+			
8	TD–			

B.2 Other Cabling Considerations

Special cables are required in two specific instances:

- When connecting to pre-standard devices
- When connecting between two ATM switches

Both of these instances are discussed below.

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B.2.1 Converter Cables

Some early ATM 25-Mbps adapters, such as the IBM TURBOWAYS 25 ATM adapter (P/N 04H7370), use a pre-standard pin assignment schema based on the token-ring network cabling standard. To make these adapters compatible with the Forum-compliant ports of the 8285 switch, it is necessary to use a token-ring-to-ATM converter cable, available from IBM as P/N 10H3904. The pinouts for this cable are shown in Table 40.

Table 40. Pin Assignments for Converter Cable (P/N 10H3904)

Signal	Port Pin	Adapter Pin
RD+	1	4
RD–	2	5
TD+	7	3
TD–	8	6

B.2.2 Crossover Cables

The 8285 ports are designed to connect user devices and require a switch-to-switch crossover cable to connect to other ATM switches, just as a 10Base-T hub does. The pinouts for this cable are shown in Table 41.

Table 41. Pin Assignments for Switch-to-Switch Crossover Cable

Signal	Port Pin	Adapter Pin
RD+	1	7
RD–	2	8
TD+	7	1
TD–	8	2

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Appendix C. Part Numbers for Key Components

Table 42. Spare Parts and Accessories

Component	8285 Base Part Number	8285 Expansion Part Number
Chassis	51H4028	47H2422
Power supply	51H4030	47H2424
Fan Unit	51H4031	29H4256
Planar	51H4036	58G9929
155 Mbps multimode I/O card	51H4029	
155 Mbps monomode I/O card	51H3861	
25 Mbps 4 Ports Expansion Card	51H4037	
Rear Panel		58G9831
ATM 2-Port 155 Mbps Flexible Media Module		58G9863
ATM 3-Port 155 Mbps LAN Concentration Module		51H4474
ATM 4-Port 100 Mbps MIC Fiber Module		58G5845
ATM 4-Port 100 Mbps SC Fiber Module		51H3650
Video Distribution Module		37H7725
ATM 12-Port 25 Mbps UTP Concentrator Module		51H3829
ATM 4-Port TR/Ethernet Bridge Module		58G9858
ATM WAN Module		51H4328
ATM 1-Slot Carrier Module		58G9860
ATM 2-Slot Carrier Module		47H2402
1-port E3 I/O card		51H4335
1-port DS3 I/O card		51H4338
1-port OC3 I/O card (SMF)		51H4558
1-port OC3 I/O card (MMF)		51H4673
1-port STM1 I/O card (SMF)		51H4557
1-port STM1 I/O card (MMF)		51H4674
1-port ATM 155Mbps Multi-mode Fiber I/O card		58G9667
1-port ATM 155 Mbps Single-mode Fiber I/O card		58G9855
1-port ATM 155 Mbps UTP/STP I/O card (RJ-45)		58G9858
Interposer 25-pin F/M shielded	58G6756	
Cable DTE/DCE 3.0m	58G6757	
Cable DTE/DCE 13.5m	58G6758	

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Appendix D. Hints and Tips for the ATM 4-Port TR/Ethernet Bridge Module

The ATM 4-Port TR/Ethernet Bridge Module is treated somewhat different from most of the other modules since it requires its own configuration program and is not configurable through the 8285 console.

The following is a collection of useful information concerning the ATM 4-Port TR/Ethernet Bridge Module:

```
_/_/_/
```

2.7 Recovering from corrupted 8281 configuration.

---

1. IMPORTANT NOTICES

WARNING: PLEASE NOTE THAT BOTH THE CONFIGURATION UTILITY PROGRAM DISKETTE IMAGE AND THE OPERATIONAL SOFTWARE FILE FOR THE NWAYS 8285 ATM LAN BRIDGE MODULE ARE DIFFERENT FROM THE STAND ALONE 8281 ATM LAN BRIDGE MODULE. IN ORDER TO CLEARLY DISTINGUISH BETWEEN BOTH PRODUCTS, ALL THE NWAYS 8285 ATM LAN BRIDGE MODULE FILES ARE PREFIXED WITH AN "H" (LIKE HUB).
THE CONFIGURATION UTILITY DISKETTE IMAGE FILE IS NAMED H8281CXY.DSK (X,Y being the release and subrelease levels), AND THE BRIDGE OPERATIONAL SOFTWARE FILE IS NAMED HX_YY.OPR (same notice for X,Y).

1.1 Operational Software Versions

For logistical reasons, the version of software loaded on the bridge may differ from the version shipped on the accompanying diskette. You will need to locally attach the Configurator, via RS-232 null-modem cable, to the bridge and examine the software Vital Product Data (VPD) returned by the bridge. Go to Utilities->Additional Utilities->Retrieve Bridge Status Report and view the status report which contains the VPD.

The software versions are identified, primarily, by a Release and Subrelease. For example, Release 2, Subrelease 1 would be identified by the dot decimal number : v2.1 .

If the software VPD returned to the Configurator from the bridge shows Release and Subrelease information that is vastly different (eg, 4.15) from the version information on the "Operational Software and MIB" diskette label, then new Operational Software needs to be loaded onto the bridge. The existing code is under a different (older) versioning scheme.

If the software VPD returned to the Configurator from the bridge has the same Release information as on the diskette but the Subrelease is higher then the bridge has the later version. The version of code already on the bridge is more recent than the version of code on the diskette. You should acquire backup copies of the most recent version of Operational Software (See "1.1.1 Where to Get Updates").

1.1.1 Where to Get Updates

The most recent versions of the ATM LAN Bridge module software (Configurator and Operational) can be gotten from the following sources:

1) The ATMBIN disk on ATMPE user at LGEVMA system (Consult your IBM service representative).

2) The IBM Networking World Wide Web home page:
http://www.raleigh.ibm.com/826/826fix.html
Select "ATM TR/Ethernet LAN Bridge module (FC 5204)" entry.
Further instructions are provided online.

1.1.2 What to do if operational code FLASH is corrupted.

If code download terminates abnormally then operational code FLASH may become corrupted. If this happens then bridge can not forward frames, or respond to most configurator commands. However, bridge can still communicate with configurator to load operational code via the serial port.

1 - Select "Load new code image via serial port" from "Utilities" menu.

2 - Choose the image to load.

3 - Select OK.

The configurator will automatically determine that the FLASH is corrupted and print a message stating that fact.

1.2 Configuration Utility Installation

Before you can use the ATM LAN Bridge Module Configuration Utility program you have to run the ATM LAN Bridge Module Configuration install setup program so it will work properly on your computer. You cannot just copy the files from the Installation disk to your hard disk. The files on the distribution disk are packed to save space. The install program unpacks those files and builds them on your working disk.

1. Make Windows' "Program Manager" the active window.

2. From Windows' "Program Manager", select "File", then select "Run". This will open the "Run" dialog box.

   Place the ATM LAN Bridge Module Configuration Utility Installation disk in your floppy drive. Type in the dialog box the command that will run the install program.

   If your floppy disk goes in your Drive "A", type:
   A:INSTALL
   If your floppy disk goes in your Drive "B", type:
   B:INSTALL

   Leave the "Run Minimized" box un-selected, and click the "OK" command button (or press "Enter").

3. After a brief moment you will be prompted by a dialog box to enter the desired location for the ATM LAN Bridge Module Configuration Utility. This is the location that you want your Configuration files to be placed. It will suggest a drive and directory of "C:\IBM8281".

   If you want the ATM LAN Bridge Module Configuration program files installed on a different drive or directory, just click the pointer to the right of the characters you want to change, backspace over the ones you want to erase, then type in the new designation.

4. The install program will unpack the necessary files and place them into your directory. The status of the operation will be displayed as the setup program does this work.

5. The ATM LAN Bridge Module Configuration Utility will be automatically added to the program manager.

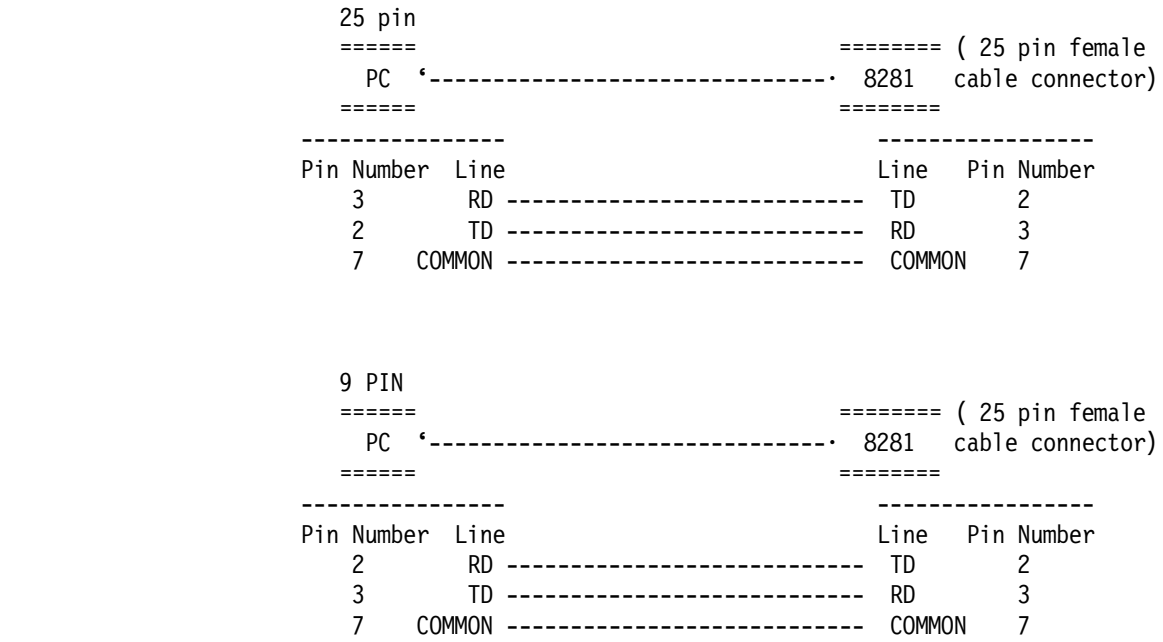
6. The setup program will notify you when the installation is complete.

1.3 TCP/IP SLIP Connection Setup

In order to communicate with the ATM LAN Bridge Module hardware, the Configuration Utility uses TCP/IP via the winsock.dll. The configurator has been thoroughly tested with the IBM versions of TCP/IP (DOS and OS/2). However it has been demonstrated to work with the Chameleon TCP/IP protocol stack from NetManage and Win95 from Microsoft.

```
*************************************************************************
*** You will need a NULL modem cable to directly attach to the bridge ***
*** using the SLIP interface.                                         ***
*************************************************************************
```

End to end the cable needs the following lines:



NULL MODEM CABLES

NOTICE: The Transmit and Receive line #'s are reversed on the 9 and 25 connectors (on the PC side).

```
*****************************************************************
****      IMPORTANT NOTE REGARDING - UART TYPE                ****
*****************************************************************
```

>>>NOTE: It is HIGHLY recommended that you use a workstation that has a Type 2 UART to ensure reliable transfer of data between the workstation and the ATM LAN Bridge Module.

If you are not sure what type of UART your machine has SLIP will display the UART type on bringup. When SLIP

is started it will display a line of information
in a box across the screen. The UART type will be
presented in this display.

If you can locate the UART chip, it's type can be determined
from the table below:

TYPE 1: 8250, 16450
TYPE 2: 16550, 16550A, 16550AF, 16550AFN

Type 1 UART's only have single character buffer while the
Type 2 UART's have a 16 character buffer. The problem is
that Windows applications have trouble fetching characters
fast enough to prevent the next incoming character from
overwriting the single character buffer, resulting in
"comm overrun" errors. Sometimes running Windows in the
"standard" mode will permit the configurator to work on a
Type 1 UART. To start Windows in the "standard" mode bring
it up by typing:

C:\win /s

Also, certain TSR's, screen savers, and some video cards
can aggravate this problem. This is a well documented
problem and much discussion can be found by searching the
world wide web for the keyword "UART".

1.3.1 IBM DOS TCP/IP SLIP Connection Setup

IBM TCP/IP with CSD 2.1.1.4 MUST be already installed on the workstation.
This version or later of IBM TCP is required! Use the TCP/IP CUSTOM
application to set and enable the COM# port as a SLIP interface with the
following configuration:

```
         IP Address:  1.2.3.6
Destination Address:  1.2.3.5
        Modem speed:  19200 bps
               Port:  COM#
```

Note: # is the number of the COM port to be used.

Because communications may be over a SLIP connection, running with
Microsoft Windows, statements MUST be added to the SYSTEM.INI file
to prevent Windows from taking over the COM ports. Add the following
3 statements to the ·386Enh‘ stanza of SYSTEM.INI for each COM
COM port which is to be used by SLIP:

```
·386Enh‘
  Com#AutoAssign=0
  Com#Base=0
  Com#Irq=-1
```

Note: # is the number of the COM port to be disabled.

AFTER YOU MAKE THESE CHANGES, YOU MUST RESTART WINDOWS!

****

```
***   Test your SLIP connection by making sure you can   ***
***   ping the bridge (ping 1.2.3.5).                    ***
************************************************************

Note: You must start TCP/IP (with tcpstart command )before
      starting Windows.
```

1.3.2 Chameleon TCP/IP SLIP Connection Setup

After Chameleon TCP/IP is installed, use the CUSTOM application to set and enable the COM# port as a SLIP interface with the following configuration:

```
         IP Address:  1.2.3.6
            Gateway:  1.2.3.5
             Modem :  direct connection
        Modem speed:  19200 bps
               Port:  COM#
       Flow control:  "none"

  Note: # is the number of the COM port to be used.
```

The following statement MUST be added to the WIN.INI file to setup the mtu size.

```
        ·TCPIP‘
           slipmtu=1500
```

You will need a NULL modem cable if you are directly attached to the bridge using the SLIP interface.

```
************************************************************
***   Test your SLIP connection by making sure you can   ***
***   ping the bridge (ping 1.2.3.5).                    ***
************************************************************
```

1.4 Configuration Utility Program and OS/2 with TCP/IP V2.0

The TCP/IP V2.x for OS/2 must be installed including DOS/Windows access. The latest OS/2 TCP/IP 2.x CSDs must also be applied including the DOS/Windows access CSD.

The TCP/IP SLIP interface must be enabled and configured by running tcpipcfg.

check the enable box

```
MTU size:                1500
VJ compression:          off
IP address:              1.2.3.6
destination IP address :  1.2.3.5
```

The speed of the com port is not set through tcpipcfg. You must explicitly change the com port speed by issuing a mode command from the OS/2 prompt.

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```
mode com1: 19200, none, 8

After setting these parameters and restarting TCP you should
first attempt to ping the 8281 bridge to prove connectivity before
using the 8281 configurator.

ping 1.2.3.5

If the ping is successful you may then use the 8281 configurator
serially attached.
```

1.5 Configuration Utility Program and OS/2 with TCP/IP V3.0

1.You must have the following installed.

- Multi-Protocol Transport Services (MPTS V2.0).
  ... with the Dos\Windows Access Kit selected.
  ... Configure LAN adapter with TCP/IP protocol.
  NOTE: If you don't have a LAN adapter you must add the following lines to your CONFIG.SYS following the line containing "DEVICE=C:\MPTN\PROTOCOL\AFOS2.SYS".

```
.
.
DEVICE=C:\MPTN\PROTOCOL\AFINET.SYS
DEVICE=C:\MPTN\PROTOCOL\IFNDIS.SYS
.
```

- TCP/IP V3.0 for OS/2

2. The serial port and TCP/IP SLIP interface must be enabled and configured.

```
MTU size:                1500
VJ compression:          off
IP address:              1.2.3.6
destination IP address :  1.2.3.5
```

```
You may want to create a command file ...
( NOTE: example shows connection to COM2)

  Line 1 => mode com2: 19200,n,8
  Line 2 => slip -com2 -ifconfig 1.2.3.6 1.2.3.5 -mtu 1500 -speed 19200

After setting these parameters and restarting TCP you should
first attempt to ping the 8281 bridge to prove connectivity before
using the 8281 configurator.

ping 1.2.3.5

If the ping is successful you may then use the 8281 configurator
serially attached.
```

1.6 SNMP MIB Browser's Handling of Octet Strings

When using some MIB Browsers (eg, NetView for AIX), don't be alarmed when queries for octet string MIB objects yield *strange* results. Typically, the browser is not able to distinguish between octet strings that are supposed to be human-readable

(ie, ASCII data) and those that are merely hexadecimal data (ie, MAC addresses). Therefore, you may be dealing with a MAC address whose bytes happen to map to the ASCII character set and your browser will reflect readable characters on the screen!

The MIB Browser shipped with the current version of NetView for AIX applies the following logic:

```
IF vector contains all human-readable bytes
   THEN represent as DisplayString.

IF all but the last byte of the vector are human-readable bytes
   AND the last byte is the null terminator (ie, '\0')
   THEN represent as DisplayString.
ELSE
   respresent as hexadecimal data.
```

For example, a MIB variable that is a 6 byte octet string having the value 0x616263313233 will be represented by the browser as "abc123".

The expectation is that additional features of SNMPv2 will allow browsers to better determine the intended representation of octet string data. Until that time, please be aware of this potentially ambiguous situation when using MIB Browser applications.

1.7 OS/2 Japan

This section provides instructions on how to run the Configuration Utility Program in a Japanese OS/2 WARP environment.

The Configurator should be installed on the workstation the same way as any other Windows application. This is accomplished by invoking WIN-OS/2 (fullscreen or Windows-on-OS/2-desktop) and installing according to the instructions in "1.2 Configuration Utility Installation" section of this README file.

Once installed, certain WIN-OS/2 DOS settings need to be set. The below steps are applied in the context of the WIN-OS/2 Fullscreen icon.

1) From the WIN-OS/2 Fullscreen icon, open the Settings dialog by double clicking the right mouse button and selecting the "Settings" popup menu item.

2) From the Settings dialog, select the "Session" tab. From the Session dialog, select the "All DOS and WIN-OS/2 Settings" radio button and click OK.

3) From the All DOS and WIN-OS/2 Settings dialog, select the DOS_DEVICE item from the settings list (on left) and set the value (on right) to "C:\TCPIP\BIN\VDOSTCP.SYS". Click on Save.

The above steps should also be applied if you desire to run the Configurator in the context of a OS/2 program icon (directly on desktop) or Windows-on-OS/2-desktop icon.

Be sure to read, and follow, the "1.4 Configuration Utility Program and OS/2" section of this README in order to insure TCP/IP communication over SLIP.

1.8 NWays Campus Manager

The ATM Forum Compliant version of the 8281 requires version 1.0.5 or above of the 8281 PSM to provide device management under NWays Campus Manager for Windows, NWays Campus Manager for AIX, and NWays Campus Manager for HP-UX.

1.9 Problems with older ATM adapter code.

The first GA code for the IBM Token Ring FC LAN Emulation ATM adapters had a bug that caused RI fields to be incorrectly constructed. This error resulted in token ring connectivity problems across the 8281 bridge. You should obtain the latest GA drivers for the adapters.

1.10 Migrating from Release 1 to Release 2 code

If you have an 8281 bridge which has Release 1 code and configuration, perform the following steps to migrate to Release 2 (Forum Compliant) code:

- Download Release 2 operational code.
- Reset the 8281 bridge (to activate Release 2 code).
- Setup Release 2 configuration using Release 2 Configurator.
- Send Release 2 profile using Release 2 Configurator.
- Reset the 8281 bridge (to activate Release 2 configuration).

---

2. RELEASE NOTES

2.1 Prerequisites

2.1.1 8285 Microcode Version

The 8285 boot microcode must be at version 1.2 (or higher) and the 8285 operationalmicrocode must be at version 1.2 (or higher). Use the SHOW DEVICE command on the CPSW console and contact your IBM service representative if required.

2.1.2 ATM server with IBM 100M bits adapter TURBOWAYS 100 OS/2 driver

If this adapter is used on the ATM server with the OS/2 device driver, the CSD level of the driver must be 1.22 or higher. If this is not the case, the MAX FRAME SIZE parameter in the OS/2 device driver PROTOCOL.INI file must be increased from 4096 to 4200 bytes. MAX FRAME SIZE value of 4096 is not compatible with NETBIOS and can create a problem if this protocol is used between the LAN clients and the ATM server.

2.2 Network Management.

The 8285 ATM LAN Bridge Module is now fully supported by the Network Management applications (up to release 1.14 of the Operational code software, the 8285 ATM LAN Bridge was handled by the Network management applications strictly in the same way as the Stand Alone 8281 ATM LAN Bridge).

ATMC PTF NUMBER UR45751 MUST BE INSTALLED AS A PREREQUISITE FOR THE 8285 ATM LAN BRIDGE SUPPORT BY THE NETWORK MANAGEMENT APPLICATIONS WITH THE BRIDGE OPERATIONAL CODE STARTING FROM LEVEL 1.15.

2.3 Problems with memory dump on machines with less than 8M RAM.

Memory dump for error log sector aborts with a system error before it completes. Memory dump should be done only at the request of product support. In most cases the partially received dump file contains enough information for analysis.

2.4 User filter clarification.

- ATM bridge supports only inbound filters.
- In Token Ring mode ATM bridge applies filters only on broadcast frames.
- In Ethernet mode ATM bridge applies filters on every frame.
- ATM bridge performs the following computation to determine whether to apply a user filter: if (frame and filter_mask) equal filter_value then apply filter.

2.5 How to connect to the bridge using a modem.

The following paragraphs explain how to configure telephone modems and TCP/IP software to enable communications via telephone lines. The ATM bridge configurator program can be used via telephone modems.

The only modem command issued by ATM bridge is ATE0 to turn echo off. The modem must be configured before it is attached to the bridge. We tested several modems, and found that the following configuration works well for Hayes compatible modems:

```
AT &F    - Restore to factory setting.
AT &K0   - Disable flow control.
AT &D0   - Allow phone connection to stay up when bridge
           resets.
AT S0=2  - Auto-Answer on second ring.
AT &W    - Save configuration.
```

Since ATM bridge communicates via TCP/IP, the SLIP protocol must be configured to dial remote modem. The dial string must be set to ATDTXXXXXXXX where "XXXXXXXX" is the telephone number, and the "Auto-Dial" option must be enabled. For some reason not enabling Auto-Dial option and using SLIPDIAL after TCP/IP is started does not work.

Once connection is established between modems, ping the bridge at 1.2.3.5 to verify connectivity. We noticed that it may take up to 30 seconds for some modems to forward pings successfully. The delay is probably due to auto learning of DTE speed between modem and ATM bridge. The bridge communicates on it's serial port at 19200, 8 data, 1 stop, no parity.

To insure that your modem is compatible with the bridge, reset the bridge while modem is attached and powered on, but does not have phone connection. After the bridge resets verify that you can dial in and ping the bridge. One modem we tested, Motorola Codex 3260, did not pass this test. The problem was most likely caused by ATM bridge sending various messages out the serial port while it is resetting.

2.6 Problem: Configurator communication errors when Max Frame Size is reduced below 1500 bytes.

Release 1 versions of the bridge and Configurator would allow IP frames as large as 1518 bytes. If the bridge's "Max Frame Size" is set lower than this the 8281 bridge will throw away the IP frames (and subsequent retries) to and from the configurator. Thus the configurator and bridge could not complete Profile sends or retrievals successfully. Release 2 of the 8281 and configurator should work with "Max Frame Size" set to 1112 bytes or higher. If there is a

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requirement to set the "Max Frame Size" lower than 1112, then you will need to use the serial port for communicating with the bridge.

2.7 Recovering from corrupted 8281 configuration.

If you observe unusual problems after loading bridge profile or loading new operational code then it is possible that 8281 configuration is corrupted. To return the bridge into it's "uninitialized" state use the configurator utilities menu to erase the configuration.

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Appendix E. IBM ATM Campus Switch Private MIBs

This appendix shows the latest version (Version 1.6, Oct 1996) of IBM ATM campus switch private MIBs:

- IBM Hub-Specific MIB Extensions
- IBM Signalling Extensions
- IBM PVC Management Extensions
- IBM ATM Statistics MIB Extensions

```
--
-- Copyright (c) 1995 International Business Machines Corp.
-- All Rights Reserved.
--

-- ================================================================
-- Version: 1.1 - 07/07/95
-- + agents OID for different products
-- + administrative OID for test types
-- + interface new administrative state wrap-reply
-- + interface new operational states for wrap & failing
-- + interface clocking, scrambling, subslot
-- + interface available and reserved bandwidth
-- + swap microcode
-- + switch statistics
--
-- Version: 1.2 - 08/17/95
-- + interface new operational states for bandwidth configuration
-- + switch max bandwidth
-- + version of backup microcode
--
-- Version: 1.3
-- + new tftp error code: file-already-exists
-- + new interfaceMediaType: coaxial-cable and backplane
-- + switchStatistics: rename into globalThroughput
-- + atm kit (utopia) carrier module support
-- + interfaceTable: new attribute maxBandwidth
-- + interfaceTable: new attribute frame format
-- + interfaceTable: new value for interfaceOperState:
--   disabled-no-bandwidth
-- + interfaceTable: interfaceScrambling becomes read-only
--
-- Version: 1.4
-- + support for the 8285: expansion group, featureTable
-- + moduleTable: support for the daughter cards on the atm kit
-- + support for the redundant switch
-- + support for config filetype and the save/revert option
--
-- Version: 1.5
-- + expansion group
-- + 25M module support
-- + LAN Emulation group
-- + integrated MSS server
-- + WAN interfaces
-- + functionsConfiguration
```

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```
-- + Hub Chassis: chassisAgents, conc, env, modules, ocPower, ocInventory.
-- + moduleOperState: incompatible-level
-- + interfaceTable: interfaceScrambling becomes read-write
--
-- Version: 1.6
-- + 3x155M module support
-- + chassis traps
-- + PVC multicast calltype added
-- + PVC multicast : Add createAndWait value for atmPvcEpRowStatus
-- ====================================================================

ATM-SWITCHING-NODE-MIB DEFINITIONS ::= BEGIN

IMPORTS
        Counter, Gauge, IpAddress, DisplayString, enterprises,
               TimeTicks
            FROM RFC1155-SMI

        OBJECT-TYPE
            FROM RFC-1212

        sysObjectID, ifPhysAddress, ifIndex
            FROM RFC1213-MIB;


ibm                          OBJECT IDENTIFIER ::= { enterprises 2 }

ibmProd                      OBJECT IDENTIFIER ::= { ibm 6 }

atmSw                        OBJECT IDENTIFIER ::= { ibmProd 33 }
                             -- Contact JB. Schmitt (SCHMITT at LGEPROFS)

-- TEXTUAL CONVENTIONS ================================================

DateAndTime ::= OCTET STRING (SIZE(8))

            -- A date and time specification, from SNMPv2 RFC 1443
            --
            -- Octets Contents        Range
            -- ====== ========        =====
            --  1-2   year            0..65535
            --  3     month           1..12
            --  4     day             1..31
            --  5     hour            0..23
            --  6     minutes         0..59
            --  7     seconds         0..60  (use 60 for leap-second)
            --  8     deci-seconds    0..9

RowStatus ::= INTEGER {
                      active(1),
                      notInService(2),
                      notReady(3),
                      createAndGo(4),
                      createAndWait(5),
                      destroy(6)
                     }

            -- A way of creating/deleting rows in tables,
            -- from RMON RFC 1271 and SNMPv2 RFC 1443
```

```
                --
                -- active: row available for use by the managed device
                -- notInService: row exists but is unavailable for use
                -- notReady: row exists but some information is missing
                -- createAndGo: create and use row
                -- createAndWait: create row but do not use it now
                -- destroy: remove row

        NetPrefix ::= OCTET STRING (SIZE(0..13))

                -- A network prefix part, as defined in the UNI V3.0 specification

        AtmAddress ::= OCTET STRING (SIZE(0..20))

                -- An ATM Address, as defined in the UNI V3.0 specification
                -- It consists of a network prefix part and an End-User part
                --
                -- Three types of format exist for the network prefix part:
                --  a = DCC Format
                --  b = ICD Format
                --  c = E.164 Format
                --
                -- The End-User part consists of an ESI and a SEL area.
                --
                --    01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
                --
                -- a=AFI!.DCC.!DFI!..AA...!RSRVD!.RD..!AREA.!.....ESI........!SEL
                -- b=AFI!.ICD.!DFI!..AA...!RSRVD!.RD..!AREA.!.....ESI........!SEL
                -- c=AFI!....E.164..............!.RD..!AREA.!.....ESI........!SEL


        -- IBM-8260 ATM MIB ======================================================

        -- ATM sub-system: ATM switch + ATM modules

        node OBJECT IDENTIFIER ::= { atmSw 1 }

        -- Agent Identification

        agents OBJECT IDENTIFIER ::= { atmSw 2 }

        ibm8260 OBJECT IDENTIFIER ::= { agents 1 }
        ibm8285 OBJECT IDENTIFIER ::= { agents 2 }

        -- Administrative Objects

        admin OBJECT IDENTIFIER ::= { atmSw 3 }

        testType OBJECT IDENTIFIER ::= { admin 1 }
        internalLoopback OBJECT IDENTIFIER ::= { testType 1 }
        externalLoopback OBJECT IDENTIFIER ::= { testType 2 }

        -- Node Objects

        base OBJECT IDENTIFIER ::= { node 1 }

        dateTime OBJECT-TYPE
                SYNTAX  DateAndTime
                ACCESS  read-write
```

```
        STATUS  mandatory
        DESCRIPTION
                "The local date and time in the ATM agent."
        ::= { base 1 }

lastChange OBJECT-TYPE
        SYNTAX  DateAndTime
        ACCESS  read-only
        STATUS  deprecated
        DESCRIPTION
                "The date and time of the last major change detected:
                 - date and time reset
                 - agent IP address(es), subnet mask(s), default gateway changed
                 - LAN Emulation or IP ARP server address(es) changed
                 - system parameters (name, contact, location) changed
                 - module Changed
                   -- module added/removed
                   -- administrative State changed (isolate/attached)
                 - interface changed:
                   -- administrative State changed (enabled/disabled)
                   -- operational state changed

                 This variable is updated in relation with the following traps:
                 - hello trap
                 - change trap
                 - linkUp/linkDown traps."
        ::= { base 2 }

lock OBJECT-TYPE
        SYNTAX  INTEGER {
                         secured (1),
                         unlock (2),
                         disabled (3)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The purpose of this variable is to protect the path between
                 the hub and the network management station.

                 When set to secure (1), it is not possible to:
                 - disable a port:
                   -- if the SNMP request was received on this port
                   -- if a LAN Emulation or an IP ARP server is on this port
                 - isolate a module:
                   -- if the SNMP request was received on this port
                   -- if a LAN Emulation or an IP ARP server is on this port

                 When set to unlock (2), the parameters referenced
                 above can be modified for a limited time (30 seconds).

                 When set to disabled (3), no protection is provided.

                 Trying to modify one of these parameters results in a
                 genErr error code in the Get-Response and a trap is
                 returned to the agent."
        ::= { base 3 }

ipArpServerAtmAddress OBJECT-TYPE
```

```
        SYNTAX  AtmAddress
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The ATM address of the ARP server used when communicating
                 with the switch agent using Classical IP over ATM (RFC 1577)."
        ::= { base 4 }

-- base.5 intentionnally left unused

systemState OBJECT-TYPE
        SYNTAX  INTEGER {
                         reset (1),
                         switch-a (2),
                         switch-b (3),
                         base-only (4)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "This variables indicates the currently active switch.
                 When the active switch is in slots 9/10, switch-a is returned.
                 When the active switch is in slots 11/12, switch-b is returned.
                 On a 8285 ATM workgroup, when there is no expansion
                 installed, base-only is returned; when there is an
                 expansion installed, switch-a is returned.
                 When reset is set, the complete atm-subsystem is reset and a
                 switch swap over may occur if the switch electing conditions
                 have changed since the last reset."
        ::= { base 6 }

backupMode  OBJECT-TYPE
        SYNTAX  INTEGER {
                         noBackUp (1),
                         primary (2),
                         secondary (3)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "This variable controls the way the active switch
                 will be elected at the next reset of the atm subsystem,
                 and controls also the reset of the atm-subsystem.
                 When set to primary, the switch module currently in use
                 is defined as the primary switch to elect as the active
                 switch, if possible, at the next reset of the atm subsystem.
                 When set to secondary, the switch module currently in use
                 is defined as the secondary switch. If another switch
                 module is present, and can be elected then this
                 other switch will become the active
                 switch, at the next reset of the atm subsystem.
                 noBackUp is returned for the atm subsystems which do
                 not support the redundant switch function."
        ::= { base 7 }

functionsConfiguration  OBJECT-TYPE
        SYNTAX  INTEGER {
                         dynamicRouting-noLanEmulationServer (1),
                         staticRouting-LanEmulationServer (2),
```

```
                        dynamicRouting-LanEmulationServer (3)
                       }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "This variable controls the configuration of the
                 functions in the control point.
                 This attribute cannot be set in the 8285, when read,
                 on a 8285 functionsConfiguration is always equal to
                 dynamicRouting-LanEmulationServer.
                 When this attribute is set, the configuration of
                 the functions is saved in the non volatile memory
                 and the atm subsystem is automatically reset.
                 When dynamicRouting-noLanEmulationServer is set
                 the dynamic routing function is active. The selection
                 of the routes when a connection is established
                 will be automatic through the SSI ports.
                 The LAN emulation servers cannot be started if
                 functionsConfiguration is equal to
                 dynamicRouting-noLanEmulationServer.
                 When staticRouting-LanEmulationServer is set, no automatic
                 route selection accross the SSI ports will be performed
                 by the atm-subsystem.
                 The routing will be performed only through the
                 defined static routes.
                 The ports cannot be set with the atm access equal to SSI.
                 All the ports previously configured as SSI ports are
                 changed to UNI, when the atm-subsystem is restarts after
                 the change of functionsConfiguration into
                 staticRouting-LanEmulationServer.
                 dynamicRouting-LanEmulationServer cannot be set on an
                 8260."
        ::= { base 8 }


-- Traps Control

traps OBJECT IDENTIFIER ::= { node 2 }

hello OBJECT-TYPE
        SYNTAX  INTEGER  {
                          enabled (1),
                          disabled (2)
                         }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "When disabled, the hello trap is neither sent.
                 When enabled, the hello trap can be sent by the agent when the
                 appropriate trap condition is detected."
        ::= { traps 1 }

-- Physical Description

physical OBJECT IDENTIFIER ::= { node 3 }

-- Switch Control

switchTable  OBJECT-TYPE
```

```
        SYNTAX  SEQUENCE OF SwitchEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table controls slot attachement to the ATM switch.
                 An ATM module is operational only when inserted in a slot which
                 is defined as attached to the switch."
        ::= { physical 1}

switchEntry OBJECT-TYPE
        SYNTAX  SwitchEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of switchTable. Each entry corresponds to a slot that
                 is physically wired to the switch. These slots may be attached
                 to or isolated from the ATM switch."
        INDEX { switchSlotIndex }
        ::= { switchTable 1 }

SwitchEntry ::= SEQUENCE {
        switchSlotIndex
                INTEGER,
        switchAdminState
                INTEGER,
        switchOperState
                INTEGER
       }

switchSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "A slot number controlled by the switch."
        ::= { switchEntry 1 }

switchAdminState OBJECT-TYPE
        SYNTAX  INTEGER {
                         isolate (1),
                         attach (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The desired state of the slot connection to the switch.

                 When a slot is isolated from the switch, the switch traffic
                 from this slot to the switch is disabled. As a result, if
                 an ATM module is plugged in this slot, it will not be
                 operational.

                 When a slot is attached to the switch, the switch is ready
                 to receive ATM traffic from this slot. As a result, if an
                 ATM module is plugged in this slot, it can be used for
                 ATM traffic."
        ::= { switchEntry 2 }

switchOperState  OBJECT-TYPE
```

```
        SYNTAX  INTEGER {
                        isolated (1),
                        attached (2)
                       }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The actual state of the slot connection to the switch.

                When the administrative state is set to ISOLATE, the
                operational state becomes ISOLATED.

                When the operational state is set to ATTACH, the operational
                state may become either ATTACHED or ISOLATED depending on
                the hardware current status of the slot."
        ::= { switchEntry 3 }

-- ATM modules

moduleTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF ModuleEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table provides the list of ATM modules in the hub."
        ::= { physical 2}

moduleEntry OBJECT-TYPE
         SYNTAX  ModuleEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of moduleTable."
        INDEX { moduleSlotIndex }
        ::= { moduleTable 1 }

ModuleEntry ::= SEQUENCE {
        moduleSlotIndex
                INTEGER,
        moduleType
                INTEGER,
        moduleDescription
                DisplayString,
        moduleSerialNumber
                DisplayString,
        moduleSoftwareVersion
                DisplayString,
        moduleHardwareVersion
                INTEGER,
        moduleAdminState
                INTEGER,
        moduleOperState
                INTEGER,
        moduleErrors
                Counter,
        moduleMaxVpc
                INTEGER,
        moduleUsedVpc
                INTEGER,
```

```
        moduleMaxVcc
                INTEGER,
        moduleUsedVcc
                INTEGER
        }

moduleSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number for this module."
        ::= { moduleEntry 1 }

moduleType OBJECT-TYPE
        SYNTAX  INTEGER {
                         unknown (1),
                         switch (2),
                         atm-100-Mbps (3),
                         atm-155-Mbps-2-ports-LAN (4),
                         atm-kit (5),
                         atm-base (6),
                         atm-lan-bridge (51),
                         atm-25-Mbps (7),
                         atm-wan (52),
                         atm-mss-server (53),
                         atm-155-Mbps-3-ports-LAN (8)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The type of module attached to the ATM switch in this
                 slot.
                 The 'unknown' value is used when the ATM agent
                 is unable to get information for this module (the
                 module is isolated from the switch or is not operational)."
        ::= { moduleEntry 2 }

moduleDescription OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..255))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "A textual description of this module.
                 This description is blank when no description is available."
        ::= { moduleEntry 3 }

moduleSerialNumber OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..13))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The serial number for this module."
        ::= { moduleEntry 4 }

moduleSoftwareVersion OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                "The version and release number for this module
                 firmware (microcode)."
        ::= { moduleEntry 5 }

moduleHardwareVersion OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Part Number (P/N) and Engineering Change (EC) level
                 for this module and Plant Location."
        ::= { moduleEntry 6 }

moduleAdminState OBJECT-TYPE
        SYNTAX  INTEGER {
                         ready (1),
                         reset (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The administrative state of this module.
                On an 8260, when set to reset for an entry associated to
                the active switch/control point module, the whole atm subsystem is
                reset and a switch swap over may occur if the backupMode
                criterium has been changed since the last reset.
                When set to reset for an entry associated to a module
                which is not the active Control Point/Switch module,
                only this module is reset."
        ::= { moduleEntry 7 }

moduleOperState OBJECT-TYPE
        SYNTAX  INTEGER {
                         unknown (1),
                         operational (2),
                         not-operational (3),
                         standby (4),
                         maintenance (5),
                         testing (6),
                         switch-error (7),
                         incompatible-level (8)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The operational state of this module.
                When unknown, the module cannot be accessed
                by the Control Point.
                When operational, the module is operational.
                When not-operational, the module is not operational.
                When standby, the module is a redundant switch module
                ready to be used.
                When maintenance, the module is a redundant switch
                module currently in maintenance mode.
                When testing, the module is a redundant switch module
                currently running diagnostics.
                When switch-error, the module is a redundant switch module
                not operational, not ready to be used because an error
```

```
                        has been detected.
                        When incompatible-level the module is a redundant switch module
                        operational, but its microcode level is not compatible with
                        the microcode level of the active control point switch
                        module and the active configuration is not copied in the
                        redundant module. If a switch over is performed, the
                        current configuration is not restored. To guarantee a
                        good restoration, the back level switch must be upgraded.
                        "
                ::= { moduleEntry 8 }

        moduleErrors    OBJECT-TYPE
                SYNTAX  Counter
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The number of errors detected by this module on the traffic
                         from the switch to this module."
                ::= { moduleEntry 9 }

        moduleMaxVpc OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The maximum number of VPC supported by this module.
                         The current number of VPC that can be used is the difference
                         between moduleMaxVpc and moduleUsedVpc."
                ::= { moduleEntry 10 }

        moduleUsedVpc OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The number of VPCs currently in use for this module.
                         The current number of VPCs that can be used is the difference
                         between moduleMaxVpc and moduleUsedVpc."
                ::= { moduleEntry 11 }

        moduleMaxVcc OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The maximum number of VCCs supported by this module.
                         The current number of VCCs that can be used is the difference
                         between moduleMaxVcc and moduleUsedVcc."
                ::= { moduleEntry 12  }

        moduleUsedVcc OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The number of VCC currently in use for this module.
                         The current number of VCC that can be used is the difference
                         between moduleMaxVcc and moduleUsedVcc."
                ::= { moduleEntry 13  }
```

```
-- ATM ports

portTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF PortEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table provides the list of ports attached to
                 the ATM switch (ATM ports). These ports belong to ATM modules
                 inserted in slots that are attached to the ATM switch."
        ::= { physical 3}

portEntry OBJECT-TYPE
        SYNTAX  PortEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of portTable. Each entry corresponds to a port that
                 belongs to an ATM module. This module must be inserted in a
                 slot that is attached to the ATM switch."
        INDEX { portSlotIndex,
                portIndex }
        ::= { portTable 1 }

PortEntry ::= SEQUENCE {
        portSlotIndex
              INTEGER,
        portIndex
              INTEGER,
        portInterface
              INTEGER
        }

portSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number of this port's module."
        ::= { portEntry 1 }

portIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The port number for this module."
        ::= { portEntry 2 }

portInterface OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number of this port."
        ::= { portEntry 3 }

-- ATM interfaces
```

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```
interfaceTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF InterfaceEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "For each ATM port, this table maps the MIB-II interface index for
                 this port with its physical slot and port numbers."
        ::= { physical 4}

interfaceEntry OBJECT-TYPE
        SYNTAX  InterfaceEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of the interfaceTable.
                 Each entry corresponds to a port that belongs to an ATM module.
                 This module must be inserted in a slot
                 that is attached to the ATM switch."
        INDEX { interfaceIndex }
        ::= { interfaceTable 1 }

InterfaceEntry ::= SEQUENCE {
        interfaceIndex
              INTEGER,
        interfaceSlot
              INTEGER,
        interfacePort
              INTEGER,
        interfaceConnector
              INTEGER,
        interfaceAdminState
              INTEGER,
        interfaceOperState
              INTEGER,
        interfaceAtmAccess
              INTEGER,
        interfaceMediaType
               INTEGER,
        interfaceMediaSpeed
              INTEGER,
        interfaceMediaErrors
              Counter,
        interfaceSubSlot
              INTEGER,
        interfaceClocking
              INTEGER,
        interfaceScrambling
              INTEGER,
        interfaceAvailableBandwidth
              INTEGER,
        interfaceAllocatedBandwidth
              INTEGER,
        interfaceMaxBandwidth
              INTEGER,
        interfaceFrameFormat
              INTEGER
        }
```

```
interfaceIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number of the port represented by this entry.
                 This is the same number as the index used to represent this
                 interface in the MIB-II interface table."
        ::= { interfaceEntry 1 }

interfaceSlot OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number of this ATM port's module."
        ::= { interfaceEntry 2 }

interfacePort OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The port number of this ATM port."
        ::= { interfaceEntry 3 }

interfaceConnector OBJECT-TYPE
        SYNTAX  INTEGER {
                        unknown (1),
                        internal (2),
                        mic   (3),
                        sc-Duplex (4),
                        monomode (5),
                        db-9 (6),
                        rj45 (7),
                        bnc (8),
                        db-15 (9)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Whether this port is an internal port (on the backplane)
                 or an external connector."
        ::= { interfaceEntry 4 }

interfaceAdminState OBJECT-TYPE
        SYNTAX  INTEGER {
                        enabled (1),
                        disabled (2),
                        wrap-reply (3),
                        wrap-far-end (4)
                        }
         ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The administrative state for this port.
                 When set to disabled, no ATM traffic can pass on this
                 port; all connections (SVC and PVC) are cleared.
                 When set to wrap-reply, this interface is wrapped so that
```

```
                        all the traffic received from the attached line is sent
                        back on this line. If the interface state is not changed,
                        it will automatically go back to the disabled state after
                        one minute.
                        When interfaceAdminState is equal to wrap-far-end,
                        then the interface located on the other side of the
                        link is now wrapped.
                        wrap-reply can only be set for 155 and wan ports.
                        wrap-far-end cannot be set."
                ::= { interfaceEntry 5 }

        interfaceOperState OBJECT-TYPE
                SYNTAX  INTEGER {
                                unknown (1),
                                disabled-nosignal (2),
                                disabled-idle (3),
                                no-signal (4),
                                idle (5),
                                in-service (6),
                                pvcOnly (7),
                                failing-internal (8),
                                misConfigured (9),
                                wrongNetworkPrefix (10),
                                wrongNodeNumber (11),
                                disabled-failing (12),
                                failing-line (13),
                                wrap-no-signal (14),
                                wrap-idle (15),
                                wrap-failing-internal (16),
                                wrap-failing-line (17),
                                idle-no-bandwidth (18),
                                idle-internal-error (19),
                                disabled-no-bandwidth (20),
                                wrap-far-end-no-signal (21),
                                wrap-far-end-idle (22),
                                wrap-far-end-failing (23),
                                wrap-far-end-failing-line (24)
                                }
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The operational state for this port:
                         - unknown: the status of this port is unknown (this can
                                    be the result of a module in error)
                         - disabled-nosignal: no activity is detected at the physical
                                              layer while the port is disabled.
                                              If the port is a SSI port, the
                                              bandwidth configuration is valid.
                         - disabled-idle:: activity from the remote device
                                           attached to this port has been
                                           detected by the physical layer.
                                           The port is disabled.
                                           If the port is a SSI port, the bandwidth
                                           configuration is valid.
                         - failing: an internal hard error has been detected on
                                    this port while the port is enabled
                         - no signal: no activity is detected at the physical
                                      layer while the port is enabled
                         - idle: activity from the remote device attached to this
```

```
       port has been detected by the physical layer.
       The port is enabled.
- in-service: the remote device successfully acknowledges
             ILMI polling requests and SVC registration
- pvcOnly: the remote device succesfully acknowledges
          ILMI polling requests but it rejects the ATM
          prefix registration. Only PVCs are supported.
- misConfigured: an SSI to UNI or an SSI to NNI configuration
                 has been detected
- wrongNetworkPrefix: the switches on each end of an SSI link
                      have incompatible network prefixes (the
                      12 first bytes have different values)
- wrongNodeNumber: the switches on each end of an SSI link
                   have the same ATM node Numbers.
- failing-line: the port is enabled and a invalid
                signal is detected on the line
- disabled-failing: the port is disabled and an
                    anomaly is detected, either internal
                    or external.
- wrap-no-signal: the port is internally wrapped so that
             all the traffic received on the attached line is
             returned unchanged on the line.
             No activity is detected at the physical
             layer.
- wrap-idle: the port is internally wrapped so that
            all the traffic received on the attached line is
            returned unchanged on the line and
            a valid signal is detected on the line.
- wrap-failing-internal: an internal failure has been
                         detected when the port has been
                         turned into the wrap-reply state.
                         The actual state of the port is
                         undefined.
- wrap-failing-line: the port is internally wrapped so that
                     all the traffic received on the attached
                     line is returned unchanged on the line
                     and an invalid signal is detected
                     on the line.
- idle-no-bandwidth: the port is enabled and activity
                from the remote device is detected but
                there is not enough bandwidth to operate
                the port with its current configuration.
                This state does not apply for UNI port.
- idle-internal-error: The port is enabled and activity
                from the remote device is detected but
                an internal error has occurred during
                the checking of the bandwidth configuration.
                This may be due to a lack of connection
                ressources in the module where this port is
                located.
- disabled-no-bandwidth:
                the enabling of the port is not
                possible because
                there is not enough bandwidth to operate
                the port with its current configuration.
                This state applies only for a SSI port.
- wrap-far-end-no-signal:
                the port is in wrap-far-end
                mode, ie the remote end of the line is
```

```
                                        wrapped, and no signal is detected on the
                                        line.
                        - wrap-far-end-idle:
                                        the port is in wrap-far-end
                                        mode, ie the remote end of the line is
                                        wrapped, and a valid signal is detected
                                        on the line.
                        - wrap-far-end-failing:
                                        the port is in wrap-far-end
                                        mode, ie the remote end of the line is
                                        wrapped, and an internal error is detected.
                        - wrap-far-end-failing-line:
                                        the port is in wrap-far-end
                                        mode, ie the remote end of the line is
                                        wrapped, and an invalid signal is detected
                                        on the line.

                        When disabled, the port may be in only one of the following
                        states:
                        - unknown, disabled-failing, disabled-nosignal or
                          disabled-idle, disabled-no-bandwidth."
                ::= { interfaceEntry 6 }

        interfaceAtmAccess OBJECT-TYPE
                SYNTAX  INTEGER {
                                unknown (1),
                                uni (2),
                                ssi (3),
                                nni (4)
                                }
                ACCESS  read-write
                STATUS  mandatory
                DESCRIPTION
                        "The type of ATM access offered on this port:
                         - UNI: User Network Interface
                         - SSI: Switch-to-Switch interface
                         - NNI: Network-to-Network interface.
                         The ATM access can be modified only when the
                         port is disabled."
                ::= { interfaceEntry 7 }

        interfaceMediaType OBJECT-TYPE
                SYNTAX  INTEGER {
                                unknown (1),
                                monomode-fiber (2),
                                multimode-fiber (3),
                                twistedPair (4),
                                utp (5),
                                stp (6),
                                coaxial-cable (7),
                                backplane (8),
                                long-range-fiber (9)
                                }
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The type of media supported on  this port."
                ::= { interfaceEntry 8 }
```

```
interfaceMediaSpeed OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS read-only
        STATUS  mandatory
        DESCRIPTION
                "The speed of this interface, in bits per second."
         ::= { interfaceEntry 9 }

interfaceMediaErrors OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The number of physical layer errors detected on this media
                such as violation errors and length errors."
        ::= { interfaceEntry 10}

interfaceSubSlot OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "When equal to 0, this interface (and its physical connector)
                is directly located on the module identified by the slot
                number.
                When equal to a non-zero value, this number identifies a
                feature card of the module that is used by this interface."
        ::= { interfaceEntry 11}

interfaceClocking OBJECT-TYPE
        SYNTAX  INTEGER {
                         internal (1),
                         external (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The source of the bit clock used for data transmission.
                When set to external, the source is the clock received
                from the line.
                The clocking can be modified only when the
                port is disabled.
                The clocking can only be modified on 155 Mbits ports
                for which the atm access is UNI or NNI."
        ::= { interfaceEntry 12}

interfaceScrambling OBJECT-TYPE
        SYNTAX  INTEGER {
                         off (1),
                         cell (2),
                         frame (3),
                         cell-and-frame (4),
                         cell-in-receive-only (5),
                         cell-in-transmit-only (6)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "Whether data scrambling is used when transmitting on this
```

```
                        line. Scrambling may be applied at the cell level,
                        at the frame level or at cell and frame level.
                        The scrambling configuration can only be modified
                        for a wan interface.
                        cell-in-receive-only applies only for a wan interface.
                        In this case, the cells are descrambled when received,
                        and are not scrambled when transmitted.
                        cell-in-transmit-only can only be set for a wan interface.
                        In this case, the cells are not descrambled when received,
                        and are scrambled when transmitted."
                ::= { interfaceEntry 13}

        interfaceAvailableBandwidth OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "For a UNI or a NNI port: the current bandwidth available
                         for the reserved bandwidth connections on this port.
                         For a SSI port: the current bandwidth available
                         on this port.
                         It is in bits per second."
                ::= { interfaceEntry 14}

        interfaceAllocatedBandwidth OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "For a UNI or a NNI port: the bandwidth, in bits per second,
                         currently used by the reserved bandwidth connections
                         on this port.
                         For a SSI port: the bandwidth, in bits per second,
                         currently reserved on this port."
                ::= { interfaceEntry 15}

        interfaceMaxBandwidth OBJECT-TYPE
                SYNTAX  INTEGER
                ACCESS  read-write
                STATUS  mandatory
                DESCRIPTION
                        "For a SSI port: the maximum bandwidth usable on this port.
                         Out of this defined bandwidth: at most 85% are usable for
                         the reserved bandwidth connections and at least 15% are
                         usable for the  non reserved bandwidth connections.
                         The interfaceMaxBandwidth must not exceed the
                         physical bandwidth of this port: interfaceMediaSpeed.
                         The minimum valid value to set for the
                         interfaceMaxBandwidth is 60000 bps, which is the
                         bandwidth requested to set a non-reserved bandwidth
                         connection on this ssi link.
                         The interfaceMaxBandwidth must be equal on each side
                         of an SSI link to avoid route computation deadlocks.
                         The default value is equal to interfaceMediaSpeed.
                         For a port which is not a SSI port, the maximum
                         bandwidth cannot be changed and remains equal to
                         interfaceMediaSpeed.
                         The interfaceMaxBandwidth is given in bits per second.
                         The interfaceMaxBandwidth can be modified only when the
```

```
                port is disabled."
        ::= { interfaceEntry 16}

interfaceFrameFormat OBJECT-TYPE
        SYNTAX  INTEGER {
                    none (1),
                    sonet-sts-3c (2),
                    sdh-stm-1 (3),
                    ds3 (4),
                    e3 (5)
                    }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The format of the frames exchanged on this port.
                 For a 155 Mbits LAN port, 2 formats are supported:
                 sonet-sts-3c and sdh-stm-1. It can only be
                 modified if the port atm access is UNI or NNI.
                 The frame format of a wan port cannot be modified.
                 For the other ports, the frame format cannot be
                 modified and is always returned as none.
                 The frame format can be changed only when the port
                 is disabled."
        ::= { interfaceEntry 17}

-- switch statistics

globalThroughputStats  OBJECT IDENTIFIER ::= { physical 5 }

globalThroughputMonitoring OBJECT-TYPE
        SYNTAX  INTEGER {
                        on (1),
                        off (2)
                       }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
              "When on, the switch throughput is monitored.
               When off, the switch thoughput is not monitored.
               Note that the monitoring decreases the system
               overall performances."
        ::= { globalThroughputStats 1 }

globalThroughputAggregateOutCells OBJECT-TYPE
              SYNTAX  Counter
              ACCESS  read-only
              STATUS  mandatory
              DESCRIPTION
                      "The total number of cells transmitted from the
                      switch.
                      Note that this value is the aggregate throughput
                      of all the ports on several minutes."
              ::= { globalThroughputStats 2 }

receiveTopList OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
```

```
                        "The ifindexes of the five most receiving interfaces.
                         The first ifindex given is the one corresponding to
                         the interface which has received the more cells
                         during the last polling interval.
                         All ifIndexes are separated by a blank character.
                         If there are less than 5 interfaces receiving data,
                         there are less than 5 ifindexes listed."
                ::= { globalThroughputStats 3 }

        transmitTopList OBJECT-TYPE
                SYNTAX  DisplayString
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The ifindexes of the five most transmitting interfaces.
                         The first ifindex given is the one corresponding to
                         the interface which has sent the more cells
                         during the last polling interval.
                         All ifIndexes are separated by a blank character.
                         If there are less than 5 interfaces transmitting data,
                         there are less than 5 ifindexes listed."
                ::= { globalThroughputStats 4 }

        globalMaximumCellThroughput OBJECT-TYPE
                      SYNTAX  INTEGER
                      ACCESS  read-only
                      STATUS  mandatory
                      DESCRIPTION
                              "The maximal number of cells that can be transmitted
                              through the switch in one second."
                ::= { globalThroughputStats 5 }


        -- ATM optional features

        optionalFeatureTable  OBJECT-TYPE
                SYNTAX  SEQUENCE OF OptionalFeatureEntry
                ACCESS  not-accessible
                STATUS  mandatory
                DESCRIPTION
                        "This table provides the list of the optional ATM features
                        installed in the ATM subsystem."
                ::= { physical 6 }

        optionalFeatureEntry OBJECT-TYPE
                SYNTAX  OptionalFeatureEntry
                ACCESS  not-accessible
                STATUS  mandatory
                DESCRIPTION
                        "Entries of the optionalFeatureTable."
                INDEX { optionalFeatureSlotIndex,
                        optionalFeatureSubslotIndex }
                ::= { optionalFeatureTable 1 }

        OptionalFeatureEntry ::= SEQUENCE {
                optionalFeatureSlotIndex
                        INTEGER,
                optionalFeatureSubslotIndex
                        INTEGER,
```

```
        optionalFeatureHardwareVersion
                DisplayString,
        optionalFeatureNumberOfPorts
                INTEGER,
        optionalFeatureDescription
                DisplayString
        }

optionalFeatureSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..64)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number for this optional feature card."
        ::= { optionalFeatureEntry 1 }

optionalFeatureSubSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER (1..16)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The sub-slot number for this optional feature card."
        ::= { optionalFeatureEntry 2 }

optionalFeatureHardwareVersion OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Part Number (P/N) and Engineering Change (EC) level
                 and Plant Location for this optional feature card."
        ::= { optionalFeatureEntry 3 }

optionalFeatureNumberOfPorts OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The number of ports present on this feature card."
        ::= { optionalFeatureEntry 4 }

optionalFeatureDescription OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..255))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "A textual description of this optional feature.
                 This description is blank when no description is available."
        ::= { optionalFeatureEntry 5 }


-- Cross-Connect Table

connections  OBJECT IDENTIFIER ::= { node 4 }

-- VCL Cross Connect Table

vcXConnectTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF VcXConnectEntry
```

```
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains the cross-connections set-up in
                 the switch for all existing VCL-based PVCs and SVCs."
        ::= { connections 1}

vcXConnectEntry OBJECT-TYPE
        SYNTAX  VcXConnectEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of vcXConnectTable."
        INDEX { vcXInIndex ,
                vcXInVpi,
                vcXInVci,
                vcXOutIndex,
                vcXOutVpi,
                vcXOutVci }
        ::= { vcXConnectTable 1 }

VcXConnectEntry ::= SEQUENCE {
        vcXInIndex
                    INTEGER,
        vcXInVpi
                    INTEGER,
        vcXInVci
                    INTEGER,
        vcXOutIndex
                    INTEGER,
        vcXOutVpi
                    INTEGER,
        vcXOutVci
                    INTEGER,
        vcXType
                    INTEGER,
        vcXDirection
                    INTEGER
        }

vcXInIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number for this ATM port."
        ::= { vcXConnectEntry 1 }

vcXInVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The VPI value for this connection."
        ::= { vcXConnectEntry 2 }

vcXInVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
```

```
        STATUS  mandatory
        DESCRIPTION
                "The VCI value for this connection."
        ::= { vcXConnectEntry 3 }

vcXOutIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number for this ATM port."
        ::= { vcXConnectEntry 4 }

vcXOutVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The VPI value for this connection."
        ::= { vcXConnectEntry 5 }

vcXOutVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The VCI value for this connection."
        ::= { vcXConnectEntry 6 }

vcXType   OBJECT-TYPE
        SYNTAX  INTEGER { unicast (1),
                          multicast (2)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Whether this cross-connection is part of a unicast or a
                 multicast connection."
        ::= { vcXConnectEntry 7 }

vcXDirection OBJECT-TYPE
        SYNTAX  INTEGER { upstream (1),
                          downstream (2)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Whether this entry identifies this cross-connection in
                 the upstream or downstream flow, as seen from the root.

                 Downstream means that the connection was set up from the
                 in parameters (interface, VPI, VCI) to the out parameters
                 (interface, VPI, VCI).

                 In particular, for a multicast SVC, this means that the
                 call initiator (the root in this case) is on the interface
                 side labeled vcXInIndex.

                 Upstream means that the connection was set up from the
```

```
                    out parameters (interface, VPI, VCI) to the in parameters
                    (interface, VPI, VCI).

                    As a result, any cross-connection is modeled in this table
                    as two entries, depending on whether it is seen in the
                    up or down stream."
            ::= { vcXConnectEntry 8 }


-- VPL Cross-Connect Table

vpXConnectTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF VpXConnectEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains the cross-connections set-up in
                 the switch for all existing VPL-based PVCs and SVCs."
        ::= { connections 2}

vpXConnectEntry OBJECT-TYPE
        SYNTAX  VpXConnectEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of vpXConnectTable."
        INDEX { vpXInIndex ,
                vpXInVpi,
                vpXOutIndex,
                vpXOutVpi}
        ::= { vpXConnectTable 1 }

VpXConnectEntry ::= SEQUENCE {
        vpXInIndex
                    INTEGER,
        vpXInVpi
                    INTEGER,
        vpXOutIndex
                    INTEGER,
        vpXOutVpi
                    INTEGER,
        vpXType
                    INTEGER,
        vpXDirection
                    INTEGER
        }

vpXInIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number for this ATM port."
        ::= { vpXConnectEntry 1 }

vpXInVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                "The VPI value for this connection."
        ::= { vpXConnectEntry 2 }

vpXOutIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number for this ATM port."
        ::= { vpXConnectEntry 3 }

vpXOutVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The VPI value for this connection."
        ::= { vpXConnectEntry 4 }

vpXType   OBJECT-TYPE
        SYNTAX  INTEGER { unicast (1),
                          multicast (2)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Whether this cross-connection is part of a unicast or a
                 multicast connection."
        ::= { vpXConnectEntry 5 }

vpXDirection OBJECT-TYPE
        SYNTAX  INTEGER { upstream (1),
                          downstream (2)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Whether this entry identifies this cross-connection in
                 the upstream or downstream flow, as seen from the root.

                 Downstream means that the connection was set up from the
                 in parameters (interface, VPI) to the out parameters
                 (interface, VPI).

                 Upstream means that the connection was set up from the
                 out parameters (interface, VPI) to the in parameters
                 (interface, VPI).

                 As a result, any cross-connection is modeled in this table
                 as two entries, depending on whether it is seen in the
                 up or down stream."
        ::= { vpXConnectEntry 6 }


-- Neighbor Devices

neighbor OBJECT IDENTIFIER ::= { node 5 }
```

```
nbrTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF NbrEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains basic characteristics on adjacent
                 ATM devices attached to this switch."
        ::= { neighbor 1}

nbrEntry OBJECT-TYPE
        SYNTAX  NbrEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of neighborTable. Each entry corresponds to a port that
                 belongs to an ATM module. This module must be inserted in a slot
                 that is attached to the ATM switch."
        INDEX { nbrIndex }
        ::= { nbrTable 1 }

NbrEntry ::= SEQUENCE {
        localIndex
              INTEGER,
        nbrIpAddress1
              IpAddress,
        nbrIpAddress2
              IpAddress,
        nbrAtmAddress
              AtmAddress,
        nbrIndex
              INTEGER,
        nbrDescriptor
              DisplayString,
        nbrOid
              OBJECT IDENTIFIER,
        nbrName
              DisplayString,
        nbrLocation
              DisplayString,
        trunkId
              INTEGER }

localIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number for the port represented by this
                 entry."
        ::= { nbrEntry 1 }

nbrIpAddress1 OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "One of the IP addresses of the ATM SNMP agent of the node
                 attached to the port/slot defined by this entry.
                 When not available, 0.0.0.0 is returned."
```

```
        ::= { nbrEntry 2 }

nbrIpAddress2 OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "One of the IP addresses of the ATM SNMP agent of the node
                 attached to the port/slot defined by this entry.
                 When not available, 0.0.0.0 is returned."
        ::= { nbrEntry 3 }

nbrAtmAddress OBJECT-TYPE
        SYNTAX  AtmAddress
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ATM identification of the node attached to the
                 port/slot defined by this entry.
                 When not available, a null string is returned."
        ::= { nbrEntry 4 }

nbrIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The interface number of the adjacent node to which the
                 connection defined by this entry is attending.
                 When not available, 0 is returned."
        ::= { nbrEntry 5 }

nbrDescriptor OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..255))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The value of the MIB-II sysDescr as reported by the
                 device attached to this port.
                 When not available, a null string is returned."
        ::= { nbrEntry 6 }

nbrOid OBJECT-TYPE
        SYNTAX  OBJECT IDENTIFIER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The value of the MIB-II sysOID as reported by the
                 device attached to this port.
                 When not available, a null string is returned."
        ::= { nbrEntry 7 }

nbrName OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..255))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The value of the MIB-II sysName as reported by the
                 device attached to this port.
```

```
                When not available, a null string is returned."
        ::= { nbrEntry 8 }

nbrLocation OBJECT-TYPE
        SYNTAX  DisplayString (SIZE (0..255))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The value of the MIB-II sysLocation as reported by the
                 device attached to this port.
                 When not available, a null string is returned."
        ::= { nbrEntry 9 }

trunkId OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The internal identifier for this trunk.
                 Set to 0 if not a trunk."
        ::= { nbrEntry 10 }


-- TFTP

tftp OBJECT IDENTIFIER ::= { node 6 }

transferControl OBJECT-TYPE
        SYNTAX  INTEGER {
                         ready (1),
                         download (2),
                         upload (3)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "A file transfer is initiated through a start command."
        ::= { tftp 1 }

transferDate OBJECT-TYPE
        SYNTAX  DateAndTime
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The date and time of the last transfer."
        ::= { tftp 2 }

serverIpAddress OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The IP address of the server used for file transfer."
        ::= { tftp 3 }

fileName OBJECT-TYPE
        SYNTAX  DisplayString (SIZE(0..128))
        ACCESS  read-write
        STATUS  mandatory
```

```
        DESCRIPTION
                "The name of the file to transfer."
        ::= { tftp 4 }

fileType OBJECT-TYPE
        SYNTAX  INTEGER {
                        unknown (1),
                        bootCode (2),
                        operationalCode (3),
                        errorLog (4),
                        systemTrace (5),
                        trsTrace (6),
-- (7) intentionnally left unused
                        trsDump (8),
                        configuration (9)
                       }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The type of file to transfer.
                 Boot and operational codes can only be dowlnoaded.
                 Logs, traces and dumps can only be uploaded. "
        ::= { tftp 5 }

fileTarget OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The module target to which the transfer applies.
                 When set to 0, the transfer applies to the agent itself."
        ::= { tftp 6 }

transferResult OBJECT-TYPE
        SYNTAX  INTEGER { not-initialized (1),
                          transfer-successful (2),
                          upload-in-progress (3),
                          download-in-progress (4),
                          generic-error (5),
                          no-response-from-host (6),
                          connection-lost (7),
                          file-not-found (8),
                          file-empty (9),
                          file-too-big (10),
                          access-rights-violation (11),
                          invalid-file-header (12),
                          checksum-error (13),
                          transfer-error (14),
                          hardware-error (15),
                          file-already-exists(16),
                          config-unreadable-version(17),
                          config-file-empty(18),
                          config-impossible(19),
                          config-internal-error(20),
                          config-applied-ok(21)
                          }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
```

```
                        "The result of the latest file transfer.
                         When one of the TFTP variables is modified, this
                         variable is reset to not-initialized.
                         When a configuration file is downloaded, the content of
                         the configuration file is checked. If the file is valid
                         and if a reset is mandatory then the atm subsystem is
                         reset automatically.
                         If the configuration file is not valid or if a reset
                         is not required, the following values are returned in
                         transferResult:
                          - config-unreadable-version: the control point
                                does not support the version of configuration file.
                                This configuration file has probably been built
                                by a further version of control point.
                          - config-file-empty: the configuration file is not valid
                          - config-impossible: the configuration file cannot
                                be applied (internal error, or file corrupted)
                          - config-internal-error: internal error detected while
                                checking the configuration file.
                          - config-applied-ok: the configuration file is valid
                                and a reset is not mandatory."
                ::= { tftp 7 }

        -- Service

        service OBJECT IDENTIFIER ::= { node 7 }

        -- Traces

        traces OBJECT IDENTIFIER ::= { service 1 }

        sysTrace OBJECT-TYPE
                SYNTAX  INTEGER { on (1),
                                  off (2)
                                }
                ACCESS  read-write
                STATUS  mandatory
                DESCRIPTION
                        "When on, the hub general trace facility is started.
                         Messages are stored in the hub in a file that can be
                         retrieved through TFTP.
                         When off, the general trace facility is stopped and
                         messages are no longer logged."
                         ::= { traces 1 }

        trsTrace  OBJECT-TYPE
                SYNTAX  INTEGER { on (1),
                                  off (2)
                                }
                ACCESS  read-write
                STATUS  mandatory
                DESCRIPTION
                        "When on, the Topology and Routing Selection trace is
                         started.
                         Messages are stored in the hub in a file that can be
                         retrieved through TFTP.
                         When off, the control point trace facility is stopped and
                         messages are no longer logged."
                ::= { traces 2 }
```

```
-- Dumps

dumps OBJECT IDENTIFIER ::= { service 2 }

-- dumps.1 intentionnally left unused

trsDump  OBJECT-TYPE
        SYNTAX  INTEGER { ready (1),
                          start (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "When start is selected, a dump of the Topology and Route
                 Services component is taken.
                 The dump is stored in the hub in a file that can be
                 retrieved through TFTP."
        ::= { dumps 2 }

-- Microcode swap

swap OBJECT IDENTIFIER ::= { service 3 }

swapControl OBJECT-TYPE
        SYNTAX  INTEGER { ready (1),
                          swap (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "When swap is selected, the backup microcode image is
                 checked and, if valid, activated.
                 The previously active microcode image becomes
                 the backup image.
                 The atm subsystem is reset."
        ::= { swap 1 }


swapResult OBJECT-TYPE
        SYNTAX  INTEGER { not-initialized (1),
                          swap-successful (2),
                          swap-in-progress (3),
                          checksum-error (4) }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The result of the latest microcode swap.
                 When an operational code image is downloaded or
                 when the system is reset, swapControl becomes
                 not-initialized."
        ::= { swap 2 }


swapBackupVersion OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
```

This soft copy for use by IBM employees only.

```
                "The version and release number for the backup
                 firmware (microcode) saved in flash memory."
        ::= { swap 3 }


-- configuration save/revert

configuration OBJECT IDENTIFIER ::= { service 4 }

configurationControl OBJECT-TYPE
        SYNTAX  INTEGER {
                         ready (1),
                         save (2)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "When set to save (2), the current configuration of the atm subsystem
                 is saved in non volatile memory.
                 This configuration will be restored at the next reset of the atm sub-
                 system.
                 It may be useful before an upload of the configuration file is
                 performed, to save the current configuration (cf tftp group).
                 When a reset is performed, the last configuration saved in non
                 volatile memory is restored and not necessarily the current config
                 at the time of the reset."
        ::= { configuration 1 }


-- This MIB defines ATM signalling support, i.e. Q2931 and SAAL support
-- for SVCs.

atmSvc OBJECT IDENTIFIER ::= { node 9 }

-- This group defines support for the Q2931 protocol

atmQ2931 OBJECT IDENTIFIER ::= { atmSvc 1 }

-- This table defines the Q2931 configuration and status.

atmQ2931ConfTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmQ2931ConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains basic information on the Q2931 protocol
                 for each signalling link defined per port.
                 Usually, there is only one signalling channel per interface
                 and thus one Q2931 protocol definition entry per interface."
        ::= { atmQ2931 1}

atmQ2931ConfEntry OBJECT-TYPE
        SYNTAX  AtmQ2931ConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmQ2931ConfTable. Each entry corresponds to a pair
                 of ATM interface, signalling channel.
                 A signalling channel is uniquely defined on each interface
```

```
                 by the VPI and VCI values allocated to it."
        INDEX { atmQ2931ConfIndex,
                atmQ2931SiVpi,
                atmQ2931SiVci }
        ::= { atmQ2931ConfTable 1 }

AtmQ2931ConfEntry ::= SEQUENCE {
        atmQ2931ConfIndex
                INTEGER,
        atmQ2931SiVpi
                INTEGER,
        atmQ2931SiVci
                INTEGER,
        atmQ2931T303
                INTEGER,
        atmQ2931T308
                INTEGER,
        atmQ2931T309
                INTEGER,
        atmQ2931T310
                INTEGER,
        atmQ2931T316
                INTEGER,
        atmQ2931T317
                INTEGER,
        atmQ2931T322
                INTEGER,
        atmQ2931T398
                INTEGER,
        atmQ2931T399
                INTEGER,
        atmQ2931SetupRetry
                INTEGER,
        atmQ2931ReleaseRetry
                INTEGER,
        atmQ2931RestartRetry
                INTEGER,
        atmQ2931StatusRetry
                INTEGER }

atmQ2931ConfIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface which, with the
                 signalling channel defined by its Vpi/Vci values,
                 uniquely identifies this entry."
        ::= { atmQ2931ConfEntry 1 }

atmQ2931SiVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vpi value which, with the Vci value specified in
                 atmQ2931SiVci, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
```

```
                 defined by Vpi=0,Vci=5."
        ::= { atmQ2931ConfEntry 2 }

atmQ2931SiVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vci value which, with the Vpi value specified in
                 atmQ2931SiVpi, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmQ2931ConfEntry 3 }

atmQ2931T303 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T303 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 4 }

atmQ2931T308 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T308 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 5 }

atmQ2931T309 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T309 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 6 }

atmQ2931T310 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T310 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 7 }

atmQ2931T316 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T316 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 8 }

atmQ2931T317 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                "T317 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 9 }

atmQ2931T322 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T322 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 10}

atmQ2931T398 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T398 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 11 }

atmQ2931T399 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "T399 timer as defined in the ATM UNI Specification."
        ::= { atmQ2931ConfEntry 12 }

atmQ2931SetupRetry OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Number of set-up retries as defined in the ATM UNI
                Specification."
        ::= { atmQ2931ConfEntry 13 }

atmQ2931ReleaseRetry OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Number of release retries as defined in the ATM UNI
                Specification."
        ::= { atmQ2931ConfEntry 14 }

atmQ2931RestartRetry OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Number of restart retries as defined in the ATM UNI
                Specification."
        ::= { atmQ2931ConfEntry 15 }

atmQ2931StatusRetry OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                "Number of status retries as defined in the ATM UNI
                Specification."
        ::= { atmQ2931ConfEntry 16 }

-- This table defines the Q2931 statistics.

atmQ2931StatsTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmQ2931StatsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains statistics for the Q2931 protocol."
        ::= { atmQ2931 2 }

atmQ2931StatsEntry OBJECT-TYPE
        SYNTAX  AtmQ2931StatsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmQ2931ConfTable. Each entry corresponds to a pair
                 of ATM interface, signalling channel.
                 A signalling channel is uniquely defined on each interface
                 by the VPI and VCI values allocated to it."
        INDEX { atmQ2931StatsIndex,
                atmQ2931StatsVpi,
                atmQ2931StatsVci }
        ::= { atmQ2931StatsTable 1 }

AtmQ2931StatsEntry ::= SEQUENCE {
        atmQ2931StatsIndex
                INTEGER,
        atmQ2931StatsVpi
                INTEGER,
        atmQ2931StatsVci
                INTEGER,
        atmQ2931OutCallAttempts
                Counter,
        atmQ2931OutCallInProgress
                Gauge,
        atmQ2931OutCallFailures
                Counter,
        atmQ2931InCallAttempts
                Counter,
        atmQ2931InCallInProgress
                Gauge,
        atmQ2931InCallFailures
                Counter }

atmQ2931StatsIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface which, with the
                 signalling channel defined by its Vpi/Vci values,
                 uniquely identifies this entry."
        ::= { atmQ2931StatsEntry 1 }
```

```
atmQ2931StatsVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vpi value which, with the Vci value specified in
                 atmQ2931StatsVci, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmQ2931StatsEntry 2 }

atmQ2931StatsVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vci value which, with the Vpi value specified in
                 atmQ2931StatsVpi, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmQ2931StatsEntry 3 }

atmQ2931OutCallAttempts OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the number of outgoing call attempts on this
                 interface, including accepted as well as rejected calls."
        ::= { atmQ2931StatsEntry 4 }

atmQ2931OutCallInProgress OBJECT-TYPE
        SYNTAX  Gauge
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the current number of outgoing calls in progress
                 on this interface."
        ::= { atmQ2931StatsEntry 5 }

atmQ2931OutCallFailures OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the number of outgoing calls that were cleared
                 for a reason other than a DTE or operator initiated action."
        ::= { atmQ2931StatsEntry 6 }

atmQ2931InCallAttempts  OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the number of incoming call attempts on this
                 interface, including accepted as well as rejected calls."
        ::= { atmQ2931StatsEntry 7 }
```

```
atmQ2931InCallInProgress OBJECT-TYPE
        SYNTAX  Gauge
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the current number of incoming calls in progress
                 on this interface."
        ::= { atmQ2931StatsEntry 8 }

atmQ2931InCallFailures   OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "This is the number of calls that were rejected by the
                 receiver."
        ::= { atmQ2931StatsEntry 9 }

-- This table contains basic information about calls in progress.
-- It allows the network operater to force clear an SVC.
-- Its implementation is optional.

atmSvcTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmSvcEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains basic information for each active
                 Switched Virtual Connection (SVC)."
        ::= { atmQ2931 3 }

atmSvcEntry OBJECT-TYPE
        SYNTAX  AtmSvcEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmSvcTable. Each entry uniquely
                 defines two end-points of an SVC. In the case of a
                 multicast SVC, each entry is defined by the
                 association of the root and one party."
        INDEX { atmSvcInterfaceIndex,
                atmSvcSiVpi,
                atmSvcSiVci,
                atmSvcCallReference,
                atmSvcEndPointReference }
        ::= { atmSvcTable 1 }

AtmSvcEntry ::= SEQUENCE {
        atmSvcInterfaceIndex
                INTEGER,
        atmSvcSiVpi
                INTEGER,
        atmSvcSiVci
                INTEGER,
        atmSvcCallReference
                INTEGER,
        atmSvcEndPointReference
                INTEGER,
```

```
        atmSvcCallingNumber
                AtmAddress,
        atmSvcCalledNumber
                AtmAddress,
        atmSvcClear
                INTEGER,
        atmSvcCreationTime
                DateAndTime,
        atmSvcVpi
                INTEGER,
         atmSvcVci
                INTEGER }

atmSvcInterfaceIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface used by this
                 SVC."
        ::= { atmSvcEntry 1 }

atmSvcSiVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vpi value which, with the Vci value specified in
                 atmSvcSiVci, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSvcEntry 2 }

atmSvcSiVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vci value which, with the Vpi value specified in
                 atmSvcSiVpi, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSvcEntry 3 }

atmSvcCallReference OBJECT-TYPE
        SYNTAX  INTEGER (0..8388607)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Q2931 call reference value used for this SVC."
        ::= { atmSvcEntry 4 }

atmSvcEndPointReference OBJECT-TYPE
        SYNTAX  INTEGER (0..16383)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
```

```
                        "One of the Q2931 end point reference values used by this
                         SVC.
                         In a unicast SVC, there is only one entry for this SVC in
                         the table.
                         In a multicast SVC, there is one entry per party."

                ::= { atmSvcEntry 5 }

        atmSvcCallingNumber OBJECT-TYPE
                SYNTAX  AtmAddress
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The calling number carried in the calling party number
                         information element of the call set-up message."
                ::= { atmSvcEntry 6 }

        atmSvcCalledNumber OBJECT-TYPE
                SYNTAX  AtmAddress
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The called number carried in the called party number
                         information element of the call set-up message."
                ::= { atmSvcEntry 7 }


        atmSvcClear OBJECT-TYPE
                SYNTAX  INTEGER {
                                 active (1),
                                 clear (2)
                                }
                ACCESS  read-write
                STATUS  mandatory
                DESCRIPTION
                        "This variable allows a network manager to clear this
                         SVC.
                         When this SVC is cleared (either by the manager using
                         this variable or by one of the parties), the entry is
                         deleted from this table and another entry is created
                         in the atmSvcClearTable."
                ::= { atmSvcEntry 8}

        atmSvcCreationTime OBJECT-TYPE
                SYNTAX  DateAndTime
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The date and time this call was placed."
                ::= { atmSvcEntry 9 }

        atmSvcVpi   OBJECT-TYPE
                SYNTAX  INTEGER (0..255)
                ACCESS  read-only
                STATUS  mandatory
                DESCRIPTION
                        "The VPI value used by this SVC for this interface."
                ::= { atmSvcEntry 10}
```

```
atmSvcVci   OBJECT-TYPE
        SYNTAX  INTEGER (0..65535)
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The VCI value used by this SVC for this interface."
        ::= { atmSvcEntry 11}

-- This table keeps track of all SVCs that have been cleared.
-- It allows to build traffic mattrix and provide more in-depth.
-- statistics level on the use of the network.
-- It is optional.

atmSvcLogSize OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The maximum number of entries supported by this local
                 SNMP agent.
                 When this value is exceeded, the entries are wrapped."
        ::= { atmQ2931 4 }

atmSvcLogLevel OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The maximum number of entries that can be written in the
                 atmSvcLogTable before a trap is generated.
                 When this number is reached, an svcLogOverflow trap is
                 generated.
                 When set to 0, no trap is generated."
        ::= { atmQ2931 5 }

atmSvcLogTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmSvcLogEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains a list of the latest Switched
                 Virtual Connection (SVC) that were completed on this
                 ATM node.
                 An SVC is completed when it has been torn down at the
                 originator's request (normal completion) or by the
                 network operator (forced tear down), or when it has
                 been rejected or cleared by the network (exceptional
                 condition)."
        ::= { atmQ2931 6 }

atmSvcLogEntry OBJECT-TYPE
        SYNTAX  AtmSvcLogEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmSvcLogTable."
        INDEX { atmSvcLogIndex }
        ::= { atmSvcLogTable 1 }
```

```
AtmSvcLogEntry ::= SEQUENCE {
        atmSvcLogIndex
                INTEGER,
        atmSvcLogInterfaceIndex
                INTEGER,
        atmSvcLogCallingNumber
                AtmAddress,
        atmSvcLogCalledNumber
                AtmAddress,
        atmSvcLogCreationTime
                DateAndTime,
        atmSvcLogTime
                DateAndTime,
        atmSvcLogClearCause
                INTEGER,
        atmSvcLogForwardQOS
                INTEGER,
        atmSvcLogBackwardQOS
                INTEGER,
        atmSvcLogForwardBW
                INTEGER,
        atmSvcLogBackwardBW
                INTEGER }

atmSvcLogIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "An identification value for this entry, assigned by the
                 local SNMP agent.
                 This value is assigned for each new SVC call or
                 add-party request.
                 This index is allocated in a decreasing order, so that
                 a get-next request on the table allows to retrieve the
                 latest calls first."
        ::= { atmSvcLogEntry 1 }

atmSvcLogInterfaceIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface used by this
                 SVC."
        ::= { atmSvcLogEntry 2 }

atmSvcLogCallingNumber OBJECT-TYPE
        SYNTAX  AtmAddress
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The calling number carried in the calling party number
                 information element of the call set-up message."
        ::= { atmSvcLogEntry 3 }

atmSvcLogCalledNumber OBJECT-TYPE
        SYNTAX  AtmAddress
        ACCESS  read-only
```

```
        STATUS  mandatory
        DESCRIPTION
                "The called number carried in the called party number
                 information element of the call set-up message."
        ::= { atmSvcLogEntry 4 }

atmSvcLogCreationTime OBJECT-TYPE
        SYNTAX  DateAndTime
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The date and time this call was placed."
        ::= { atmSvcLogEntry 5 }

atmSvcLogTime OBJECT-TYPE
        SYNTAX  DateAndTime
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The date and time this call was cleared."
        ::= { atmSvcLogEntry 6 }

atmSvcLogClearCause OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The cause of the clearing of this SVC."
        REFERENCE
                "ATM Forum/93-265R5 Signalling Specification Draft -
                 Apr. 14, 93."
        ::= { atmSvcLogEntry 7}

atmSvcLogForwardQOS   OBJECT-TYPE
        SYNTAX  INTEGER {
--                       unspecified (0),
                         class-A (1),
                         class-B (2),
                         class-C (3),
                         class-D (4)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The forward Quality Of Service requested for this
                  call."
        ::= { atmSvcLogEntry 8}

atmSvcLogBackwardQOS   OBJECT-TYPE
        SYNTAX  INTEGER {
--                       unspecified (0),
                         class-A (1),
                         class-B (2),
                         class-C (3),
                         class-D (4)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
```

```
                "The backward Quality Of Service requested for this
                 call."
        ::= { atmSvcLogEntry 9}

atmSvcLogForwardBW   OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The forward bandwidth requested for this
                  call."
        ::= { atmSvcLogEntry 10}

atmSvcLogBackwardBW   OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The backward bandwidth requested for this
                 call."
        ::= { atmSvcLogEntry 11}

-- SAAL Group
-- This group defines support for the SAAL protocol.

atmSaal OBJECT IDENTIFIER ::= { atmSvc 2 }

-- This table defines the SAAL configuration and status.

atmSaalConfTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmSaalConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains basic information on the SAAL protocol
                 for each signalling link defined per port.
                 Usually, there is only one signalling channel per interface
                 and thus one SAAL protocol definition entry per interface."
        ::= { atmSaal 1 }

atmSaalConfEntry OBJECT-TYPE
        SYNTAX  AtmSaalConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmSaalConfTable. Each entry corresponds to a pair
                 of ATM interface, signalling channel.
                 A signalling channel is uniquely defined on each interface
                 by the VPI and VCI values allocated to it."
        INDEX { atmSaalConfIndex,
                atmSaalConfSiVpi,
                atmSaalConfSiVci }
        ::= { atmSaalConfTable 1 }

AtmSaalConfEntry ::= SEQUENCE {
        atmSaalConfIndex
                INTEGER,
        atmSaalConfSiVpi
                INTEGER,
```

```
        atmSaalConfSiVci
                INTEGER,
        atmSaalState
                INTEGER,
        atmSaalTimerPoll
                INTEGER,
        atmSaalTimerKeepAlive
                INTEGER,
        atmSaalTimerNoResponse
                INTEGER,
        atmSaalTimerCC
                INTEGER,
        atmSaalTimerIdle
                INTEGER,
        atmSaalMaxCC
                INTEGER,
        atmSaalMaxPD
                INTEGER,
        atmSaalMaxStat
                INTEGER }

atmSaalConfIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface which, with the
                 signalling channel defined by its Vpi/Vci values,
                 uniquely identifies this entry."
        ::= { atmSaalConfEntry 1 }

atmSaalConfSiVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vpi value which, with the Vci value specified in
                 atmSaalConfSiVci, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSaalConfEntry 2 }

atmSaalConfSiVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vci value which, with the Vpi value specified in
                 atmSaalConfSiVpi, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSaalConfEntry 3 }

atmSaalState OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
```

This soft copy for use by IBM employees only.

```
        DESCRIPTION
                "The state of the SAAL for this interface as defined in
                 the Q.2110 Specification, Chapter 7.3."
        ::= { atmSaalConfEntry 4 }

atmSaalTimerPoll OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Timer_POLL as defined in the Q.2110 Specification.
                 This timer is running in the active phase to assure that
                 the peer receiver is polled often enough to return
                 its status."
        ::= { atmSaalConfEntry 5 }

atmSaalTimerKeepAlive OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Timer_KEEP-ALIVE as defined in the Q.2110 Specification.
                 This timer is started when entering the transient phase."
        ::= { atmSaalConfEntry 6 }

atmSaalTimerNoResponse OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Timer_NO-RESPONSE as defined in the Q.2110 Specification.
                 This timer indicates the maximum time interval during
                 which at least one STAT PDU needs to be received."
        ::= { atmSaalConfEntry 7 }

atmSaalTimerCC  OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Timer_CC as defined in the Q.2110 Specification.
                 Transmission of PDUs is protected by this timer during
                 establishment and release of a connection and during
                 resynchronization or recovery."
        ::= { atmSaalConfEntry 8 }

atmSaalTimerIdle OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Timer_IDLE as defined in the Q.2110 Specification.
                 This timer is started upon receipt of a STAT PDU
                 when entering the idle phase (no POLL PDUs sent)."
        ::= { atmSaalConfEntry 9 }

atmSaalMaxCC    OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
```

```
        STATUS  mandatory
        DESCRIPTION
                "MaxCC as defined in the Q.2110 Specification.
                 This is the maximum value for the state variable
                 VT(CC), corresponding to the maximum number of
                 transmissions of a BGN, END, ER or RS PDU."
        ::= { atmSaalConfEntry 10 }

atmSaalMaxPD    OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "MaxPD as defined in the Q.2110 Specification.
                This is the maximum iacceptable value for the state
                variable VT(PD) before sending a POLL PDU and
                resetting VT(PD) to zero.
                This parameter is an upper limit for counter VT(PD)
                that sends a POLL PDU after every (MaxPD) SD PDUs."
        ::= { atmSaalConfEntry 11}

atmSaalMaxStat  OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "MaxSTAT as defined in the Q.2110 Specification.
                This is the maximum number of list elements
                placed in a STAT PDU."
        ::= { atmSaalConfEntry 12}

-- This table defines the SAAL statistics.

atmSaalStatsTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmSaalStatsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains statistics for the SAAL protocol,
                 for outgoing calls only."
        ::= { atmSaal 2 }

atmSaalStatsEntry OBJECT-TYPE
        SYNTAX  AtmSaalStatsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmSaalConfTable. Each entry corresponds to a pair
                 of ATM interface, signalling channel.
                 A signalling channel is uniquely defined on each interface
                 by the VPI and VCI values allocated to it."
        INDEX { atmSaalStatsIndex,
                atmSaalStatsSiVpi,
                atmSaalStatsSiVci }
        ::= { atmSaalStatsTable 1 }

AtmSaalStatsEntry ::= SEQUENCE {
        atmSaalStatsIndex
                INTEGER,
```

```
        atmSaalStatsSiVpi
                INTEGER,
        atmSaalStatsSiVci
                INTEGER,
        atmSaalUnexpectPdus
                Counter,
        atmSaalUnsuccessPdus
                Counter,
        atmSaalFailedEstablishment
                Counter,
        atmSaalSequenceGap
                Counter,
        atmSaalGapNumbers
                Counter,
        atmSaalOtherListErrors
                Counter,
        atmSaalLackOfCredit
                Counter,
        atmSaalCreditObtained
                Counter }

atmSaalStatsIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface which, with the
                 signalling channel defined by its Vpi/Vci values,
                 uniquely identifies this entry."
        ::= { atmSaalStatsEntry 1 }

atmSaalStatsSiVpi OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vpi value which, with the Vci value specified in
                 atmSaalStatsSiVci, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSaalStatsEntry 2 }

atmSaalStatsSiVci OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Vci value which, with the Vpi value specified in
                 atmSaalStatsSiVpi, defines the signalling channel for this
                 entry.
                 Usually, there is one signalling channel per interface
                 defined by Vpi=0,Vci=5."
        ::= { atmSaalStatsEntry 3 }

atmSaalUnexpectPdus OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                    "Error conditions A to M, as defined in the Q.2110
                     Specification.
                     This is the number of received unsolicited or
                     or inappropriate PDUs."
        ::= { atmSaalStatsEntry 4 }

atmSaalUnsuccessPdus OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "Error condition O as defined in the Q.2110
                     Specification.
                     This is the number of failing retries."
        ::= { atmSaalStatsEntry 5 }

atmSaalFailedEstablishment OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "Error condition P as defined in the Q.2110
                     Specification.
                     This is the number of failing polls."
        ::= { atmSaalStatsEntry 6 }

atmSaalSequenceGap OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "The number of times sequence gaps were
                     detected by the peer entity. "
        ::= { atmSaalStatsEntry 7 }

atmSaalGapNumbers OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "The number of times frames were
                     re-transmitted due to sequence gaps
                     detected by the peer entity."
        ::= { atmSaalStatsEntry 8 }

atmSaalOtherListErrors OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "Error conditions Q to V as defined in the
                     Q.2110 Specification."
        ::= { atmSaalStatsEntry 9 }

atmSaalLackOfCredit OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                    "Error condition W as defined in the Q.2110
                     Specification.
                     This is the number of times that transmission
                     was not permitted by the peer entity due to
                     a lack of credit."
        ::= { atmSaalStatsEntry 10 }

atmSaalCreditObtained OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                    "Error condition X as defined in the Q.2110
                     Specification.
                     This is the number of times that credit was
                     obtained from the peer entity to allow
                     transmission."
        ::= { atmSaalStatsEntry 11 }


-- This MIB defines ATM support for Permanent Virtual Circuits.

atmPvc OBJECT IDENTIFIER ::= { node 10 }

-- Global PVC Parameter

atmPvcHandler OBJECT-TYPE
        SYNTAX  INTEGER {
                         ready (1),
                         out-of-memory (2)
                        }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The status of the PVC handler in the switch.
                 When no more memory is available, the creation of new PVCs
                 is rejected with a generic Error sense code."
        ::= { atmPvc 1 }


-- PVC Table

atmPvcTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmPvcEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table lists all PVCs defined per interface.
                 There is only one entry in this table per PVC
                 (point-to-point or point-to-multipoint PVC)."
        ::= { atmPvc 2 }

atmPvcEntry OBJECT-TYPE
        SYNTAX  AtmPvcEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmPvcTable.
```

```
                    Policing parameters are those requested when
                    creating the PVC. The actual values used by the
                    network to satisfy these requirements may slightly
                    differ. These values are attached to virtual links
                    and are available in virtual link tables, such as
                    the RFC-1695 VPL/VCL tables."
            INDEX { atmPvcIndex,
                    atmPvcIdentifier }
            ::= { atmPvcTable 1 }

    AtmPvcEntry ::= SEQUENCE {
            atmPvcIndex
                    INTEGER,
            atmPvcIdentifier
                    INTEGER,
            atmPvcRowStatus
                    RowStatus,
            atmPvcType
                    INTEGER,
            atmPvcEndPoint
                    INTEGER,
            atmPvcVpi
                    INTEGER,
            atmPvcVci
                    INTEGER,
            atmPvcBackwardQos
                    INTEGER,
            atmPvcForwardQos
                    INTEGER,
            atmPvcBackwardType
                    INTEGER,
            atmPvcForwardType
                    INTEGER,
            atmPvcBackwardParm1
                    INTEGER,
            atmPvcForwardParm1
                    INTEGER }

    atmPvcIndex OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-only
            STATUS  mandatory
            DESCRIPTION
                    "The ifIndex value of the ATM interface used by this PVC."
            ::= { atmPvcEntry 1 }

    atmPvcIdentifier OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-only
            STATUS  mandatory
            DESCRIPTION
                    "A value used to uniquely identify this PVC on this
                     interface.

                     To create a new PVC on a given interface, an unused PVC
                     identifier must be found."
            ::= { atmPvcEntry 2 }

    atmPvcRowStatus OBJECT-TYPE
```

```
        SYNTAX  INTEGER { active (1),
                          notInService (2),
                          notReady (3),
                          createAndWait (5),
                          destroy (6) }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "States values:
                 active: the PVC is operational
                 notInService: the PVC is failing
                 notReady: values are missing to be able to activate this PVC

                 Actions:
                 active: this requests to re-start a failing PVC (which status
                         was notInService)
                 destroy: this requests to delete a PVC
                 createAndWait: this requests to create a PVC

                 To create a new PVC, this variable must be set to
                 createAndWait with an index where:
                 - atmPvcIndex is the number of the interface from where the
                               PVC is created
                 - atmPvcIdentifier is an unused PVC identifier for this
                                    interface

                 To activate a PVC, this variable must be set to active.

                 Default values are provided for all attributes except for the
                 atmPvcEpRemIndex. If this attribute is not set, the PVC will
                 remain in the notReady state.

                 To delete a PVC, this variable must be set to destroy."
        ::= { atmPvcEntry  3 }

atmPvcType OBJECT-TYPE
        SYNTAX  INTEGER  { point2pointVP      (1),
                           point2pointVC      (2),
                           point2multipointVP (3),
                           point2multipointVC (4) }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "A unicast PVC is defined between two endpoints, using
                 either a VP or a VC connection.
                 A Multicast PVC is defined :
                   - first between a source endpoint and a target endpoint
                   - then adding endpoints, thanks to the PvcEpTable
                 using either VP or VC connections.
                 The source endpoint is called Root, while target endpoints are
                 called multicast parties."
        DEFVAL { point2pointVC }
        ::= { atmPvcEntry 4 }

atmPvcEndPoint OBJECT-TYPE
        SYNTAX  INTEGER  { primaryRoot (1),
                           secondaryLeaf (2) }
        ACCESS  read-only
        STATUS  mandatory
```

```
        DESCRIPTION
                "The end-point where the PVC is created is identified as the
                 primary or root end-point.
                 the other end-point is the identified as the secondary or
                 leaf end-point."
        DEFVAL { primaryRoot }
        ::= { atmPvcEntry 5 }

atmPvcVpi OBJECT-TYPE
        SYNTAX  INTEGER (0..65536)
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The VPI value assigned to this PVC at the origin.
                 A value of 65536 means that no value has been specified by
                 the operator.
                 If no value has been specified, the VPI value is then
                 automatically allocated by the agent when activating the PVC."
        DEFVAL { 65536 }
        ::= { atmPvcEntry 6 }

atmPvcVci OBJECT-TYPE
        SYNTAX  INTEGER (0..65536)
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The VCI value assigned to this PVC at the origin.
                 For VP-type PVC, this value is not applicable and is
                 set to 0.
                 A value of 65536 means that no value has been specified by
                 the operator.
                 If no value has been specified, the VCI value is then
                 automatically allocated by the agent when activating the PVC."
        DEFVAL { 65536 }
        ::= { atmPvcEntry 7 }

atmPvcBackwardQos OBJECT-TYPE
        SYNTAX  INTEGER {
--                       unspecified (0),
                         class-A (1)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The QOS requested for this PVC to the originator."
        DEFVAL { unspecified }
        ::= { atmPvcEntry 8 }

atmPvcForwardQos OBJECT-TYPE
        SYNTAX  INTEGER {
--                       unspecified (0),
                         class-A (1)
                        }
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The QOS requested for this PVC from the originator."
        DEFVAL { unspecified }
        ::= { atmPvcEntry 9 }
```

```
atmPvcBackwardType OBJECT-TYPE
        SYNTAX  OBJECT IDENTIFIER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The first parameter used to define the
                policy requested for this PVC."
        ::= { atmPvcEntry 10 }

atmPvcForwardType OBJECT-TYPE
        SYNTAX  OBJECT IDENTIFIER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The type of policy requested for this PVC."
        ::= { atmPvcEntry 11 }

atmPvcBackwardParm1 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The fourth parameter used to define the
                policy requested for this PVC."
        DEFVAL { 0 }
        ::= { atmPvcEntry 12 }

atmPvcForwardParm1 OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The third parameter used to define the
                policy requested for this PVC."
        DEFVAL { 0 }
        ::= { atmPvcEntry 13 }

-- A list of all the End-Points for each PVC defined.

atmPvcEpTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF AtmPvcEpEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                 "This table lists the characteristics of the remote
                  end-points of defined PVCs.
                  There is at least one entry for each PVC defined in the atmPvcTable."
        ::= { atmPvc 3 }

atmPvcEpEntry OBJECT-TYPE
        SYNTAX  AtmPvcEpEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of atmPvcEpTable.
                 One entry is automatically created by the agent when a
                 PVC is created in the PVC Table.
                 No additional entry can be created in this table if the
```

```
                 PVC is defined as point-to-point in the PVC table."
        INDEX { atmPvcEpIndex,
                atmPvcEpIdentifier,
                atmPvcEpParty }
        ::= { atmPvcEpTable 1 }

AtmPvcEpEntry ::= SEQUENCE {
        atmPvcEpIndex
                INTEGER,
        atmPvcEpIdentifier
                INTEGER,
        atmPvcEpParty
                INTEGER,
        atmPvcEpRowStatus
                RowStatus,
        atmPvcEpStatusCause
                INTEGER,
        atmPvcEpRemAddress
                NetPrefix,
        atmPvcEpRemIndex
                INTEGER,
        atmPvcEpRemVpi
                INTEGER,
        atmPvcEpRemVci
                INTEGER,
        atmPvcEpLastActive
                DateAndTime,
        atmPvcEpQ2931Cause
                INTEGER,
        atmPvcEpFailures
                Counter }

atmPvcEpIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The ifIndex value of the ATM interface used by this PVC."
        ::= { atmPvcEpEntry 1 }

atmPvcEpIdentifier OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "A value used to uniquely identify this PVC on this
                 interface.

                 This is the same identifier as the one used in the atmPvcTable
                 to identify the PVC that this end-point belongs to."
        ::= { atmPvcEpEntry 2 }

atmPvcEpParty OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "A value used to uniquely identify a remote end-point of a PVC,
                 when associated with an interface index and a PVC identifier.
```

This soft copy for use by IBM employees only.

```
                    For a point-to-point PVC, this value is always set to 0."
            ::= { atmPvcEpEntry 3 }

    atmPvcEpRowStatus OBJECT-TYPE
            SYNTAX  INTEGER { active (1),
                              notInService (2),
                              notReady (3),
                              createAndWait (5),
                              destroy (6) }
            ACCESS  read-write
            STATUS  mandatory
            DESCRIPTION
                    "States values:
                     active: the PVC is operational
                     notInService: the PVC is failing
                     notReady: values are missing to be able to activate this PVC

                     Actions:
                     active: this requests to re-start a failing unicast PVC
                             (status was notInService)
                     destroy: this requests to delete a unicast PVC."
            ::= { atmPvcEpEntry  4 }

    atmPvcEpStatusCause OBJECT-TYPE
            SYNTAX  INTEGER { noCause (1),
                              underModification (2),
                              missingParameters (3),
                              invalidParameters (4),
                              uncompatibleParameters (5),
                              internalFailure (6),
                              pvcFailure (7),
                              unavailableResource (8),
                              remoteBusy (9),
                              retrying (10)
                              }
            ACCESS  read-only
            STATUS  mandatory
            DESCRIPTION
                    "A detailed cause for the current PVC status."
            ::= { atmPvcEpEntry 5 }

    atmPvcEpRemAddress OBJECT-TYPE
            SYNTAX  NetPrefix
            ACCESS  read-write
            STATUS  mandatory
            DESCRIPTION
                    "The ATM address of the remote ATM switch where the PVC
                     ends.
                     If none is specified, the ATM address of the target
                     switch (local) is used and the PVC is confined to the
                     target switch (local switch)."
            ::= { atmPvcEpEntry 6 }

    atmPvcEpRemIndex OBJECT-TYPE
            SYNTAX  INTEGER
            ACCESS  read-write
            STATUS  mandatory
            DESCRIPTION
```

```
                "The ifindex value used at the remote end to identify the
                 interface where the PVC ends.
                 This entry will remain in the notReady state until this
                 attribute is set (and the atmPvcRowStatus is set to active)."
        ::= { atmPvcEpEntry 7 }

atmPvcEpRemVpi OBJECT-TYPE
        SYNTAX  INTEGER (0..65536)
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The VPI value assigned to this PVC at the destination
                 (remote end).
                 If left at 65536  (default value), one value is
                 automatically allocated by the agent."
        DEFVAL { 65536 }
        ::= { atmPvcEpEntry 8 }

atmPvcEpRemVci OBJECT-TYPE
        SYNTAX  INTEGER (0..65536)
        ACCESS  read-write
        STATUS  mandatory
        DESCRIPTION
                "The VCI value assigned to this PVC at the destination.
                 For VP-type PVC, this value is not applicable and is
                 set to 0.
                 If left at 65536 (default value), one value is
                 automatically allocated by the agent (for VC only)."
        DEFVAL { 65536 }
        ::= { atmPvcEpEntry  9 }

atmPvcEpLastActive OBJECT-TYPE
        SYNTAX  DateAndTime
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The date and time of the latest PVC activation."
        ::= { atmPvcEpEntry  10}

atmPvcEpQ2931Cause OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The cause of the failure as defined by Q2931."
        ::= { atmPvcEpEntry  11}

atmPvcEpFailures OBJECT-TYPE
        SYNTAX  Counter
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The number of times this PVC failed."
        ::= { atmPvcEpEntry 12 }


-- The group atmLanEmulation defines the specific support for
-- the lan emulation resources in the atm node
```

```
lanEmulation OBJECT IDENTIFIER ::= { node 11 }

lanEmulationServer OBJECT IDENTIFIER ::= { lanEmulation 1 }

lesConfTable  OBJECT-TYPE
        SYNTAX  SEQUENCE OF LesConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "This table contains the specific configuration
                 parameters of the embedded LAN emulation servers."
        ::= {lanEmulationServer  1}

lesConfEntry OBJECT-TYPE
        SYNTAX  LesConfEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "Entries of the lesConfTable. Each entry corresponds to
                 a Lan emulation server embedded in the atm control point."
        INDEX { lesIndex }
        ::= { lesConfTable 1 }

LesConfEntry ::= SEQUENCE {
        lesIndex
              INTEGER,
        lesMaxNumberOfClients
              INTEGER,
        lesLecLastChange
              INTEGER }

lesIndex OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  not-accessible
    STATUS  mandatory
    DESCRIPTION
           "A value which uniquely identifies a
                  lan emulation server in the lesConfTable."
    ::= { lesConfEntry  1 }

lesMaxNumberOfClients OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
           "The maximum number of clients supported by
            this lan emulation server.
            The maximum number of clients cannot be set
            if the associated LES is started.
            The total number of clients on all the embedded
            lan emulation servers in one node must not exceed 128."
    ::= { lesConfEntry  2 }

lesLecTableLastChange OBJECT-TYPE
    SYNTAX  TimeTicks
    ACCESS  read-only
    STATUS  mandatory
    DESCRIPTION
           "The value of the sysUpTime the last time a change was detected
```

```
            in a lesLecEntry associated to the given lesIndex.
            The lesLecEntry is defined in the lesMIB."
    ::= { lesConfEntry  3 }


-- ================================================================
-- Traps
-- ================================================================

hello TRAP-TYPE
      ENTERPRISE node
      VARIABLES { sysObjectID, ifPhysAddress }
      DESCRIPTION
      " A hello trap is sent:
        - when the system re-initializes: it is sent every minutes until
          an SNMP request is received or until 255 minutes have passed.
        - when one of the following parameters is changed:
          -- agent IP address(es)
          -- agent subnet mask(s)
          -- ATM address of the IP ARP server
          -- IP address of the default gateway
        The value of ifPhysAddress is the ATM address of the hub.
        The hello trap may be disabled."
      ::= 1

lock TRAP-TYPE
     ENTERPRISE node
     VARIABLES { moduleSlotIndex }
     DESCRIPTION
     " A lock trap is sent when a set request is rejected because it is
       suspected that this may cause to break the link between the agent
       and the manager. This may occur when:
       - isolating a slot
       - disabling a port
       if the request is received through this specific port/module/slot."
     ::= 2

change TRAP-TYPE
       ENTERPRISE node
       VARIABLES { moduleSlotIndex, ifIndex }
       DESCRIPTION
       " A change trap is sent when one of the following MIB variables or
         group of variables is changed:
         - Date and Time reset
         - System Parameters (name, contact, location) changed
         - Interface changed:
           -- Administrative State (enabled/disabled)
         - Module changed:
           -- Administrative State (isolate/attach)
         When one of this variable is changed, the lastChange MIB object is
         also updated with the current date and time.
         When the Date and Time or the System Parameters changed,
         the interface number of the hub virtual interface is returned.
         This trap may be disabled."
       ::= 3

pvcFailure TRAP-TYPE
           ENTERPRISE node
           VARIABLES { atmPvcIndex, atmPvcIdentifier, atmPvcEpQ2931Cause }
```

```
            DESCRIPTION
            " A PVC failure trap is sent when a PVC becomes inoperational."
            ::= 4

-- node.5 intentionnally left unused

callLoggingOverflow TRAP-TYPE
          ENTERPRISE node
          DESCRIPTION
          " A callLoggingOverflow trap is sent when the call logging table
           is about to wrap."
          ::= 6

moduleInstalled TRAP-TYPE
          ENTERPRISE node
          VARIABLES { moduleSlotIndex }
          DESCRIPTION
          " An ATM module has been detected in the hub."
          ::= 7

moduleRemoved TRAP-TYPE
            ENTERPRISE node
            VARIABLES { moduleSlotIndex }
            DESCRIPTION
            " An ATM module is no longer detected in the hub."
            ::= 8

lesMaxClientsReached TRAP-TYPE
            ENTERPRISE node
            VARIABLES { lesIndex }
            DESCRIPTION
            "The maximum number of lan emulation
            clients has been connected to the given lan emulation
            server."
            ::= 9

lesMaxClientsThresholdDown TRAP-TYPE
            ENTERPRISE node
            VARIABLES { lesIndex }
            DESCRIPTION
            "The number of operational clients of the given emulated
            lan is now equal to lesMaxNumberOfClients - 10.
            This trap is sent only if  the
            trap lesMaxClientsReached has been sent previously.
            lesIndex is the index of the lesConfTable defined above"
            ::= 10

-- Expansion Description

expansion OBJECT IDENTIFIER ::= { atmSw 4 }

expansionHardwareVersion OBJECT-TYPE
        SYNTAX  DisplayString
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The Part Number (P/N) and Engineering Change (EC) level
                 and Plant Location for this module."
        ::= { expansion 1 }
```

```
-- Chassis management

chassis         OBJECT IDENTIFIER ::= { atmSw 5 }


--
-- Hub Chassis Groups
--

chassisAgents   OBJECT IDENTIFIER ::= { chassis   1 }
conc            OBJECT IDENTIFIER ::= { chassis   2 }
env             OBJECT IDENTIFIER ::= { chassis   3 }
modules         OBJECT IDENTIFIER ::= { chassis   4 }
ocPower         OBJECT IDENTIFIER ::= { chassis   8 }
ocInventory     OBJECT IDENTIFIER ::= { chassis   9 }

ocPowerControl  OBJECT IDENTIFIER ::= { ocPower  1 }
ocInvHub        OBJECT IDENTIFIER ::= { ocInventory 1 }
ocInvMods       OBJECT IDENTIFIER ::= { ocInventory 2 }



agentsMySlot OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The slot id of this agent."
        ::= { chassisAgents 1 }

agentsMasterReset OBJECT-TYPE
        SYNTAX  INTEGER {
                noReset(1)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The agent mastership cannot be reset.
                noReset is always returned."
        ::= { chassisAgents 2 }

agentsTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF AgentsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "A table of agents in the concentrator as seen by
                this agent.  A master will see all the agents; a slave
                will only see itself."
        ::= { chassisAgents 3 }

agentsEntry OBJECT-TYPE
        SYNTAX  AgentsEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "A profile of an agent within the concentrator."
```

```
        INDEX   { agentsSlotIndex }
        ::= { agentsTable 1 }

AgentsEntry ::=
        SEQUENCE {
                agentsSlotIndex
                        INTEGER,
                agentsStationAddr
                        OCTET STRING,
                agentsIpAddress
                        IpAddress,
                agentsMasterStatus
                        INTEGER,
                agentsMasterPriority
                        INTEGER,
                ocAgentsSubSlot
                        INTEGER
                }

agentsSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number that identifies the referenced agent."
        ::= { agentsEntry 1 }

agentsStationAddr OBJECT-TYPE
        SYNTAX  OCTET STRING (SIZE(6))
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The unique identifier for this agent.  Often this
                is the value of ifPhysAddress for the first interface."
        ::= { agentsEntry 2 }

agentsIpAddress OBJECT-TYPE
        SYNTAX  IpAddress
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "An IP Address that can be used to communicate to
                this agent.  Note, this object's value may change
                as the agent switches to different sub-networks."
        ::= { agentsEntry 3 }

agentsMasterStatus OBJECT-TYPE
        SYNTAX INTEGER {
                master(1),
                non-master(2), -- slave
                electing(3)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The mastership status of this agent."
        ::= { agentsEntry 4 }

agentsMasterPriority OBJECT-TYPE
```

```
        SYNTAX INTEGER {
                one(1),         -- lowest
                two(2),
                three(3),
                four(4),
                five(5),
                six(6),
                seven(7),
                eight(8),
                nine(9),
                ten(10),        -- highest
                never(11)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The mastership priority of this agent.  Ten is the
                highest and one is the lowest.  Never means will not
                be able become master. MasterPriority is only used
                when an election occurs. Mastership is not pre-emptive."
        ::= { agentsEntry 5 }

ocAgentsSubSlot OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The subslot index for this agent.  For agents not located
                in the IBM 8260 system, this object will always
                return 1 for this object value."
        ::= { agentsEntry 6 }


-- The conc Group:

-- This group is mandatory for all devices that are acting as a concentrator
-- master.
--
-- The conc group contains information and control relative to
-- the concentrator.
--

concType OBJECT-TYPE
        SYNTAX INTEGER {
                hub-8260-017-A(6),      -- 17-slot with ring backplane
                hub-8260-010-A(10)      -- 10-slot with ring backplane
        }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "This object identifies the type of concentrator represented
                by this agent."
        ::= { conc 1 }

concReset OBJECT-TYPE
        SYNTAX INTEGER {
                noReset(1),
                reset(2)
                }
```

```
        ACCESS read-write
        STATUS mandatory
        DESCRIPTION
                "Writing a reset(2) will reset every module in the stack
                without changing the current configuration and will zero
                all counters."
        ::= { conc 2 }

concNumSlots OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The number of slots in this concentrator.  This value is
                the sum total of all payload slots plus any slots reserved
                for controller modules.  For example, for an IBM 8260 agent
                operating in a 17-slot IBM 8260 hub, this object will have
                the value 19 (17 payload slots plus 2 controller slots)."
        ::= { conc 3 }

concProfile OBJECT-TYPE
        SYNTAX OCTET STRING (SIZE(1..3))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "A bit string containing always 00 00 00."
        ::= { conc 4 }

concDescr OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..128))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "A textual string containing information about the hub type."
        ::= { conc 5 }



-- The env Group

-- This group represents the concentrator's environment.  It is available
-- from agents that are acting as a concentrator master.

envTempStatus OBJECT-TYPE
        SYNTAX INTEGER {
                okay(1),
                extremeTemp(2),
                warning(3)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The overall temperature status for this concentrator.
                This object's value is an aggregate of all the temperature
                probes in the concentrator, such that, when at least one probe
                reports extreme temperature, this object will have the value
                extremeTemp(2).  This object will have the value warning(3)
                prior to reporting the value extremeTemp(2) as a means of
                warning of a possible hub overheat condition."
```

```
    ::= { env 1 }

envPSCapacity OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The total capacity of power supplies for this concentrator."
        ::= { env 2 }

envPSTable OBJECT-TYPE
        SYNTAX SEQUENCE OF EnvPSEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A table that contains information about each potential
                power supply in the concentrator."
        ::= { env 3 }


envPSEntry OBJECT-TYPE
        SYNTAX EnvPSEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A list of information for each power supply in the
                concentrator."
        INDEX { envPSIndex }
        ::= { envPSTable 1 }

EnvPSEntry ::=
        SEQUENCE {
                envPSIndex
                        INTEGER,
                envPSAdminState
                        INTEGER,
                envPSOperStatus
                        INTEGER
                }

envPSIndex OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "Identifies the power supply for which this entry contains
                power supply information. "
        ::= { envPSEntry 1 }

envPSAdminState OBJECT-TYPE
        SYNTAX INTEGER {
                activate(1)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current desired state of the power supply.
                activate is the only adminState reported."
        ::= { envPSEntry 2 }
```

```
envPSOperStatus OBJECT-TYPE
        SYNTAX INTEGER {
                active(1),
                standby(2),
                faulty(3),
                not-installed(4)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current operational state of the power supply.  A power
                supply in standby does not provide power to the concentrator."
        ::= { envPSEntry 3 }

envFanStatus OBJECT-TYPE
        SYNTAX INTEGER {
                okay(1),
                faulty(2),
                not-installed(4),
                unknown(5)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The overall status of the fan(s).  When fan operational
                status is known, this object's value is an aggregate of
                all fan status in the concentrator such that, when at
                least one fan unit is faulty, this object will have the
                value faulty(2)."
        ::= { env 4 }



--
-- Static Summaries
--

staticSummary OBJECT IDENTIFIER ::= { modules 12 }

staticSummaryTable OBJECT-TYPE
        SYNTAX  SEQUENCE OF StaticSummaryEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "A table for retrieving predefined collections
                of MIB objects as a single field of octets.  This
                table is read-only:  all the entries are created
                by the agent.

                The purpose of this table is to replace the
                modSummaryTable.  It can support changes in
                the MIB structure and new types of variables as
                they are added in the future.  This is accomplished
                by returning the OID of each item included in the
                summary, along with the summarized values.

                Each entry in this table summarizes important
                information concerning the configuration and status
```

```
                of a slot/subslot. This information is a summary of
                the objects in the modules branch.

                No entry in this table exists for an empty slot."
        ::= { staticSummary 1 }

staticSummaryEntry OBJECT-TYPE
        SYNTAX  StaticSummaryEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "A predefined collection of MIB objects whose
                values can be retrieved as a single field."
        INDEX   { ssSlotIndex, ssSubSlotIndex }
        ::= { staticSummaryTable 1 }

StaticSummaryEntry ::=
        SEQUENCE {
                ssSlotIndex             INTEGER,
                ssSubSlotIndex          INTEGER,
                ssValues                OCTET STRING
                }

ssSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The slot number of the slot to which this
                entry pertains."
        ::= { staticSummaryEntry 1 }

ssSubSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The subslot number to which this entry pertains.
                It is associated with a slot number. Motherboards are
                always located in subslot one, (e.g. <slot>.1). However,
                daughter cards can reside on any subslot within the range
                (2 ... 8), (e.g. <slot>.<2 .. 8>)."
        ::= { staticSummaryEntry 2 }

ssValues OBJECT-TYPE
        SYNTAX  OCTET STRING
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The OIDs and values of the objects to be summarized,
                given as an octet string in the 'New Summary' format.

                        NEW_SUMMARY DEFINITION ::= BEGIN

                        IMPORTS TimeTicks FROM RFC1155-SMI;

                        Message ::= CHOICE OF {
                                Message_0
                        }
```

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```
                                Message_0 ::= ·0“ IMPLICIT SEQUENCE {
                                        timeStamp TimeTicks,
                                        containments   CONTAINMENTS
                                }

                                CONTAINMENTS ::= SEQUENCE OF CONTAINMENT

                                CONTAINMENT ::= SEQUENCE {
                                        prefix         OID,             -- Base OID
                                        blocks         BLOCKS
                                }

                                BLOCKS ::= SEQUENCE OF BLOCK

                                BLOCK ::= SEQUENCE {
                                        suffix  SUFFIX,
                                        values  VALUES
                                }

                                SUFFIX ::= CHOICE OF {
                                        SEQUENCE OF INTEGER, -- Indicies (i.e. slot.port)
                                        NULL
                                }

                                VALUES ::= SEQUENCE OF VALUE

                                VALUE ::= SEQUENCE {
                                        attribute       INTEGER,
                                        data      DATA
                                }

                                DATA ::= CHOICE OF {
                                        INTEGER,
                                        OCTET STRING,
                                        TimeTicks
                                }

                                END”
                        ::= { staticSummaryEntry 3 }

                ssLastChangedTable OBJECT-TYPE
                        SYNTAX  SEQUENCE OF SsLastChangedEntry
                        ACCESS  not-accessible
                        STATUS  mandatory
                        DESCRIPTION
                                ”A table of timestamps each indicating the change
                                state of the corresponding information contained
                                in the staticSummaryTable.

                                This table contains a fixed number
                                of entries, one for each possible subslot in
                                each possible slot in the concentrator, regardless
                                of whether the slot or subslot is occupied.  For
                                example, for an IBM 8260 concentrator, this table
                                has 19 x 8 entries; for an Hub concentrator, which
                                has no subslots, this table has either 5 or 17 entries,
                                and the subslot index of each entry is 1.
```

```
                (Note that the number of subslot entries in this table
                is determined by the type of concentrator, not the type
                of module; for an Hub module in an IBM 8260
                concentrator, there will still be 8 subslot entries.)"
        ::= { staticSummary 2 }

ssLastChangedEntry OBJECT-TYPE
        SYNTAX  SsLastChangedEntry
        ACCESS  not-accessible
        STATUS  mandatory
        DESCRIPTION
                "An entry for a particular slot/subslot address in
                the concentrator, indicating the value of SysUpTime
                at the time of the last detected change to any of
                the information included in the corresponding
                staticSummaryEntry instance."
        INDEX   { ssTlcSlotIndex, ssTlcSubSlotIndex }
        ::= { ssLastChangedTable 1 }

SsLastChangedEntry ::=
        SEQUENCE {
                ssTlcSlotIndex          INTEGER,
                ssTlcSubSlotIndex       INTEGER,
                ssTlcCurrentlyOccupied  INTEGER,
                ssTimeLastChanged       TimeTicks
                }

ssTlcSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The number of the slot to which this entry pertains."
        ::= { ssLastChangedEntry 1 }

ssTlcSubSlotIndex OBJECT-TYPE
        SYNTAX  INTEGER
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The subslot number to which this entry pertains.
                For Hub concentrators, there is a single entry
                for each slot, with a subslot number of 1.
                For IBM 8260 concentrators, the number 1 indicates
                the motherboard, and daughterboards are numbered
                beginning with subslot 2."
        ::= { ssLastChangedEntry 2 }

ssTlcCurrentlyOccupied OBJECT-TYPE
        SYNTAX  INTEGER {
            empty(1),
            occupied(2)
            }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The current configuration state of this slot/
                subslot.  Whether occupied or not, the
                ssTimeLastChanged field is still valid:  if a
```

```
                slot/subslot is unoccupied, the timestamp indicates
                the time that the module was removed.  If no module
                has occupied this slot/subslot since the last
                restart of the agent, the value of ssTimeLastChanged
                for this entry is zero."
        ::= { ssLastChangedEntry 3 }

ssTimeLastChanged OBJECT-TYPE
        SYNTAX  TimeTicks
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "The value of SysUpTime at the time that the
                last change was detected to any of the information
                included in the summary table entry for this slot
                and subslot.  A change in the value of this object
                signals the management station to re-get the
                corresponding summary information."
        ::= { ssLastChangedEntry 4 }

ssLastChangedSummary OBJECT-TYPE
        SYNTAX OCTET STRING
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "This object contains the value of ssTimeLastChanged for
                each slot/subslot in the concentrator. The first two
                octets contain the version of this object. The data
                following the version begins with the first slot and
                all of its sub-slots before continuing with the next slot."
        ::= { staticSummary 3 }


--
-- IBM 8260 Power Group
--
-- This group is used for managing the
-- power in the IBM 8260 hub.

--
-- Hub power mode
--
ocPowerModeAdminStatus OBJECT-TYPE
        SYNTAX INTEGER {
                fault-tolerant(1),
                not-fault-tolerant(2)
                }
        ACCESS read-write
        STATUS mandatory
        DESCRIPTION
                "The current desired state of hub power fault-tolerant
                mode.  Setting this object to fault-tolerant(1) will
                reserve one power supply's worth of power from the power
                budget for fault-tolerant operation, provided sufficient
                power is available.  Setting this object to
                not-fault-tolerant(2) returns the reserved power to the
                power budget."
        ::= { ocPowerControl 1 }
```

```
ocPowerModeOperStatus OBJECT-TYPE
        SYNTAX INTEGER {
                fault-tolerant(1),
                not-fault-tolerant(2)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current operational status of hub power fault-tolerant
                mode."
        ::= { ocPowerControl 2 }

ocPowerOverheatPowerDownMode OBJECT-TYPE
        SYNTAX INTEGER {
                enable(1),
                disable(2)
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current desired state of hub overheat automatic power-
                down mode. The value enable(1) causes slots containing IBM 8260
                modules to be automatically power-disabled during a hub
                overheat condition. The value disable(2) causes no action
                to be taken when a hub overheat condition occurs."
        ::= { ocPowerControl 3 }

--
--  Hub backplane power
--
ocPowerOutputTable OBJECT-TYPE
        SYNTAX SEQUENCE OF OcPowerOutputEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A table that contains information about the hub power
                budget.  This table is indexed by voltage line type, each
                of which is supplied by the operational power supplies."
        ::= { ocPower 2 }

ocPowerOutputEntry OBJECT-TYPE
        SYNTAX OcPowerOutputEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A list of information about the hub power budget."
        INDEX { ocPowerOutputType }
        ::= { ocPowerOutputTable 1 }

OcPowerOutputEntry ::=
        SEQUENCE {
                ocPowerOutputType
                        INTEGER,
                ocPowerOutputVoltageLevel
                        Gauge,
                ocPowerOutputWattageCapacity
                        Gauge,
                ocPowerOutputWattageConsumed
                        Gauge,
```

```
                ocPowerOutputWattageAvailable
                        Gauge,
                ocPowerOutputUnmanagedWattageAlloc
                        Gauge
                }

ocPowerOutputType OBJECT-TYPE
        SYNTAX INTEGER {
                plusFiveVolt(1),        -- + 5 Volt
                minusFiveVolt(2),       -- - 5 Volt
                plusTwelveVolt(3),      -- +12 Volt
                minusTwelveVolt(4),     -- -12 Volt
                plusTwoVolt(5)          -- + 2 Volt
                }
        ACCESS  read-only
        STATUS  mandatory
        DESCRIPTION
                "Identifies the power (voltage) line type for which this
                entry contains power budget information."
        ::= { ocPowerOutputEntry 1 }

ocPowerOutputVoltageLevel OBJECT-TYPE
        SYNTAX Gauge
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "In millivolts (1/1000 Volt), the actual voltage level
                for this voltage type as sensed on the backplane.  This
                voltage is supplied by all operational power supplies."
        ::= { ocPowerOutputEntry 2 }

ocPowerOutputWattageCapacity OBJECT-TYPE
        SYNTAX Gauge
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "In hundredths of a Watt (1/100 Watt), the maximum
                wattage for the voltage line that is output by all
                operational power supplies combined."
        ::= { ocPowerOutputEntry 3 }

ocPowerOutputWattageConsumed OBJECT-TYPE
        SYNTAX Gauge
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "In hundredths of a Watt (1/100 Watt), the wattage
                consumed by all hub modules.  For a given voltage line,
                this object's value is the sum total of the power
                consumed by the hub itself, the Controller Modules
                and all power-enabled slots containing IBM 8260 modules.
                If power fault-tolerant mode is enabled (when it was
                previously disabled), this object's value is increased
                by the amount of power reserved for the voltage line.
                If power fault-tolerant mode is disabled (when it was
                previously enabled), this object's value is decreased
                by the amount of power that is returned to the available
                power budget for the voltage line."
        ::= { ocPowerOutputEntry 4 }
```

```
ocPowerOutputWattageAvailable OBJECT-TYPE
        SYNTAX Gauge
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "In hundredths of a Watt (1/100 Watt), the wattage
                available to power-up modules.  If power fault-tolerant
                mode is enabled (when it was previously disabled), this
                object's value is decreased by the amount of power reserved
                for the voltage line.  If power fault-tolerant mode is
                disabled (when it was previously enabled), this object's
                value is increased by the amount of power that is returned
                to the available power budget for the voltage line."
        ::= { ocPowerOutputEntry 5 }

ocPowerOutputUnmanagedWattageAlloc OBJECT-TYPE
        SYNTAX Gauge
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "In hundredths of a Watt (1/100 Watt), the wattage
                reserved for modules that are not power-manageable.
                This value 0 is always returned."
        ::= { ocPowerOutputEntry 6 }

--
-- Module power configuration
--
ocPowerSlotTable OBJECT-TYPE
        SYNTAX SEQUENCE OF OcPowerSlotEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A table that contains power management information
                for each non-empty, payload slot in the hub.  Note
                that for multi-slot IBM 8260 modules, there is one point
                of power management contact and control.  Hence, only
                the leftmost slot is represented in this table."
        ::= { ocPower 3  }

ocPowerSlotEntry OBJECT-TYPE
        SYNTAX OcPowerSlotEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A list of power management information for each
                payload slot in the hub containing an 8260 module."
        INDEX { ocPowerSlotIndex }
        ::= { ocPowerSlotTable 1 }

OcPowerSlotEntry ::=
        SEQUENCE {
                 ocPowerSlotIndex
                        INTEGER,
                 ocPowerSlotClass
                        INTEGER,
                 ocPowerSlotAdminStatus
                        INTEGER,
```

```
                ocPowerSlotOperStatus
                        INTEGER
                }

ocPowerSlotIndex OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The unique slot number that identifies the module
                associated with this power entry."
        ::= { ocPowerSlotEntry 1 }

ocPowerSlotClass OBJECT-TYPE
        SYNTAX INTEGER {
                one(1),
                two(2),
                three(3),
                four(4),
                five(5),
                six(6),
                seven(7),
                eight(8),
                nine(9),
                ten(10)
                }
        ACCESS read-write
        STATUS mandatory
        DESCRIPTION
                "The current slot power class.  For a slot containing
                an IBM 8260 module, this object's value ranges from 1 to
                10, where 1 is the lowest power class and 10 is the
                highest power class.  Slots assigned higher power classes
                will be power-enabled before slots assigned lower power
                classes.  Similarly, slots assigned lower power classes
                will be power-disabled before slots assigned higher power
                classes. Power class can be used to establish an
                IBM 8260 module power-up and power-down priority scheme.
                Combined with slot location, slot power class defines the
                order in which slots containing IBM 8260 modules will be
                power-enabled and power-disabled.  For a given power class,
                slots are power-enabled from lowest payload slot to highest
                payload slot and power-disabled from highest payload slot
                to lowest payload slot.  Slot power class is not pre-emptive;
                changing a slot's power class will not affect the power
                state of other slots.  It will take effect during a slot
                power-up or power-down event (e.g., the failure or recovery
                of a power supply)."
        ::= { ocPowerSlotEntry 2 }

ocPowerSlotAdminStatus OBJECT-TYPE
        SYNTAX  INTEGER {
                enable(1),  -- enable slot power
                disable(2)  -- disable slot power
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current desired slot power state.  For a slot
```

```
                containing an IBM 8260 module, the value enable(1) causes the
                module to be power-enabled, provided sufficient power is
                available. The value disable(2) causes the module to be
                power-disabled and is not allowed for a slot containing the
                IBM 8260 agent, to prevent the user from losing hub
                manageability. The slot will not receive power untill this
                object is set to the the value enable(1)."
        ::= { ocPowerSlotEntry 3 }

ocPowerSlotOperStatus OBJECT-TYPE
        SYNTAX INTEGER {
                enabled(1),             -- Slot power is enabled
                disabled(2),            -- Slot power is disabled
                insufficient-power(3),  -- Slot power up not possible
                enabled-always(4)       -- Slot power is enabled always
                }
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The current operational slot power status.  This object
                will have the value enabled(1), if the slot contains an
                IBM 8260 module and is actually power-enabled.  This object
                will have the value disabled(2), if the slot contains an
                IBM 8260 module and is actually power-disabled.  In this case,
                the slot is ineligible for power until ocPowerSlotAdminStatus
                for the slot is set to enable(1).  This object will have
                the value insufficient-power(3), if the slot is eligible to
                receive power but, due to power constraints, is not
                power-enabled.  When sufficient power becomes available, the
                slot will become power-enabled, and this object will then have
                the value enabled(1).  This object will have the value
                enabled-always(4) for a slot containing the IBM 8260 agent.
                For the slot containing the IBM 8260 agent, ocPowerSlotAdminStatus
                cannot be set to the value disable(2).  However, in the event of
                an environmental change such as a power supply failure, the slot
                containing the IBM 8260 agent may be automatically power-disabled,
                and this object will then have the value insufficient-power(3).
                This is based on the value of ocPowerSlotClass for the slot."
        ::= { ocPowerSlotEntry 4 }

--
-- IBM 8260 Inventory Group
--
-- This group reflects inventory information about
-- components in the IBM 8260 hub.
--

--
-- Hub chassis information
--
ocInvHubType OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The hub type (i.e. model number) of the hub.  An instance
                for which information is not valid will return 'invalid
                EEPROM!'."
        ::= { ocInvHub 1 }
```

```
ocInvHubSerialNo OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The serial number of the hub.  An instance for which
                information is not valid will return 'invalid EEPROM!'."
        ::= { ocInvHub 2 }

ocInvHubHWVer OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The revision number of the hardware of the hub.  An instance
                for which information is not valid will return 'invalid
                EEPROM!'."
        ::= { ocInvHub 3 }

ocInvHubMfr OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The company name that manufactured this hub.  An instance
                for which information is not valid will return 'invalid
                EEPROM!."
        ::= { ocInvHub 4 }

ocInvHubMfrDate OBJECT-TYPE
        SYNTAX DisplayString (SIZE(6))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The date in yymmdd format that this unit was manufactured.
                An instance for which information is not valid will return
                'invalid EEPROM!'."
        ::= { ocInvHub 5 }

ocInvHubNotePad OBJECT-TYPE
        SYNTAX DisplayString (SIZE(0..256))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "Note pad area reserved for the hub.  This area
                contains information pertaining to the hub such as
                service or hardware upgrade information.  An instance
                for which information is not valid will return 'invalid
                EEPROM!'."
        ::= { ocInvHub 6 }


--
-- IBM 8260 Modules inventory information
--
-- Contains information about the hub modules. The modules
-- information are organized as a base-one matrix. That is, a module,
-- motherboard or daughter card, can be located by a pair of primitives:
```

```
-- slot index and subslot index (i.e. <slot>.<subslot>)
--
-- ocInvModTable
--
ocInvModTable OBJECT-TYPE
        SYNTAX SEQUENCE OF OcInvModEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "A list of inventory information related to a module,
                indexed with respect to slot and subslot location numbers."
        ::= { ocInvMods 1 }

ocInvModEntry OBJECT-TYPE
        SYNTAX OcInvModEntry
        ACCESS not-accessible
        STATUS mandatory
        DESCRIPTION
                "Values to describe a module inventory items."
        INDEX { ocInvModSlotIndex, ocInvModSubSlotIndex }
        ::= { ocInvModTable 1 }

OcInvModEntry ::=
        SEQUENCE {
                ocInvModSlotIndex
                        INTEGER,
                ocInvModSubSlotIndex
                        INTEGER,
                ocInvModModel
                        DisplayString,
                ocInvModSerialNo
                        DisplayString,
                ocInvModHWVer
                        DisplayString,
                ocInvModSWVer
                        DisplayString,
                ocInvModSWBootVer
                        DisplayString,
                ocInvModMfr
                        DisplayString,
                ocInvModMfrDate
                        DisplayString,
                ocInvModNotePad
                        DisplayString
                }

ocInvModSlotIndex OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The slot number where this Module is located."
        ::= { ocInvModEntry 1 }

ocInvModSubSlotIndex OBJECT-TYPE
        SYNTAX INTEGER
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
```

```
                "The subslot number where this Module is located.
                It is associated with a slot number. Motherboards are
                always located in subslot one, (e.g. <slot>.1). However,
                daughter cards can reside on any subslot within the range
                (2 ... 8), (e.g. <slot>.<2 .. 8>)."
        ::= { ocInvModEntry 2 }

ocInvModModel OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "This Module model number.
                If the instance value is unknown, Hub will be returned."
        ::= { ocInvModEntry 3 }

ocInvModSerialNo OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "This Module serial number.
                If the instance value is unknown, N/A will be returned."
        ::= { ocInvModEntry 4 }

ocInvModHWVer OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The revision number of the hardware on this module.
                If the instance value is unknown, N/A will be returned."
        ::= { ocInvModEntry 5 }

ocInvModSWVer OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The revision number of the software on this module.
                If the instance value is unknown, N/A will be returned."
        ::= { ocInvModEntry 6 }

ocInvModSWBootVer OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The revision number of the boot software on this module.
                If the instance value is unknown, N/A will be returned."
        ::= { ocInvModEntry 7 }

ocInvModMfr OBJECT-TYPE
        SYNTAX DisplayString (SIZE(1..32))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The company name that manufactured this module.
                If the instance value is unknown, N/A will be returned."
```

```
        ::= { ocInvModEntry 8 }

ocInvModMfrDate OBJECT-TYPE
        SYNTAX DisplayString (SIZE(0..6))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The date in yymmdd format that this module was manufactured.
                If the instance value is unknown, N/A will be returned."
        ::= { ocInvModEntry 9 }

ocInvModNotePad OBJECT-TYPE
        SYNTAX DisplayString (SIZE(0..256))
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "Note pad area reserved for the module.  This area
                contains information pertaining to the module such as
                service or hardware upgrade information.  If the instance
                value is unknown, N/A will be returned."
        ::= { ocInvModEntry 10 }


-- Chassis related Traps sent by the 8260 ATM agent.

-- Traps are defined using the conventions in RFC 1215.

chassisSlotDown TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "This trap indicates that a module is down.
                Usually, this trap is sent when the module
                has been removed.

                Sometimes, this trap is sent when management communications
                with this module have been broken.  In this case, it may not
                be possible to distinguish between a removed and a failed
                module."
        ::= 102

chassisSlotUp TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "This trap indicates that a module is up.
                Usually, this trap is sent when the module is
                inserted into the hub.

                Sometimes, this trap is sent when management communications
                have been restored to a module where they had previously
                been broken."
        ::= 103

chassisEnvironment TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "A chassisEnvironment trap indicates a change in the
                concentrator's environment has occurred.  The variables
                supplied indicate what exactly changed."
        ::= 104
```

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```
chassisChange TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "A chassisChange trap is used to indicate that a configuration
                change has occurred.  The actual variables that changed
                are included in the variables section of the PDU."
        ::= 107

chassisModuleDown TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "A chassisModuleDown trap indicates that management communications
                with a slot has been
                broken.  This event usually occurs when a module has been
                physically removed from the concentrator.  However, it
                is possible for this event to occur when the particular
                module fails."
        ::= 116

chassisModuleUp TRAP-TYPE
        ENTERPRISE      node
        DESCRIPTION
                "A chassisModuleUp trap indicates that management communications
                with a slot has been
                established.  This event usually occurs when a module has
                physically been inserted into the concentrator.  The
                variable chipModType indicates the module type inserted."
        ::= 117


END
```

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Appendix F. Special Notices

This publication is intended to help customers and IBM technical professionals to implement ATM Networks using the IBM 8285 ATM Workgroup Switch. The information in this publication is not intended as the specification of any programming interfaces that are provided by the IBM 8285 ATM Workgroup Switch documentations. See the PUBLICATIONS section of the IBM Programming Announcement for IBM 8285 ATM Workgroup Switch for more information about what publications are considered to be product documentation.

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Appendix G. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

G.1 International Technical Support Organization Publications

For information on ordering these ITSO publications see “How To Get ITSO Redbooks” on page 281.

- *ATM Campus Introduction, Planning, and Troubleshooting Overview*, GA27-4089
- *Campus ATM Design Guidelines*, SG24-5002
- *Local Area Network Concepts and Products: Adapters, Hubs and ATM*, SG24-4754
- *IBM 8260 As a Campus ATM Switch*, SG24-5003
- *Local Area Network Concepts and Products: LAN Architecture*, SG24-4753
- *Campus ATM Network Management Guideline*, SG24-5006

G.2 Redbooks on CD-ROMs

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Application Development Redbooks Collection	SBOF-7290	SK2T-8037
Personal Systems Redbooks Collection	SBOF-7250	SK2T-8042

G.3 Other Publications

These publications are also relevant as further information sources:

- *IBM 8250/8260/8285 Planning and Site Preparation Guide*, GA33-0285
- *IBM 8285 Nways ATM Workgroup Switch Installation and User's Guide*, SA33-0381
- *IBM 8285 Nways ATM Workgroup Switch SAFETY and SERVICE Catalog*, SA33-0398
- *ATM 4-Port 100 Mbps Module Installation and User's Guide*, SA33-0324
- *Nways 8260 ATM 155 Mbps Flexible Concentration Module Installation and User's Guide*, SA33-0358
- *Nways 8260 ATM TR/Ethernet LAN Bridge Module Installation and User's Guide* SA33-0361

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- *IBM 8260/8285 ATM WAN Module Installation and User's Guide*, SA33-0396
- *8260/8285 ATM 25 MBps Concentration Module Installation and User's Guide*, SA33-0383

How To Get ITSO Redbooks

This section explains how both customers and IBM employees can find out about ITSO redbooks, CD-ROMs, workshops, and residencies. A form for ordering books and CD-ROMs is also provided.

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- **Redbooks Home Page on the World Wide Web**

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Glossary

A

AAL (ATM Adaptation Layer). The layer that adapts user data to/from the ATM network by adding/removing headers and segmenting/reassembling the data into/from cells.

AAL-5 (ATM adaptation Layer 5). One of several standard AALs, AAL-5 was designed for data communications and is used by LAN Emulation and classical IP.

ABR (Available Bit Rate). ATM Forum Service category in relation to traffic Management on ATM networks. Use bandwidth available in the running network after other traffic utilizing guaranteed bandwidth services has been serviced.

ARP (Address Resolution Protocol). IP ARP translate network addresses into hardware addresses, LE ARP translates LAN destinations into ATM addresses.

asynchronous. Any two events that are not tied together exactly in time are said to be asynchronous.

ATM (asynchronous transfer mode). A transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM layer. The layer in the protocol model which relays cells from one connection to another.

ATM peer-to-peer connection. A virtual channel connection (VCC) or a virtual path connection (VPC).

ATM user-to-user connection. An association established at the ATM layer to support communication between two or more ATM service users (that is, between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM layer connection may be either bidirectional or unidirectional. The same virtual channel identifier (VCI) is used for both directions of a connection at an interface.

ATM layer link. A section of an ATM layer connection between two active ATM layer entities (ATM entities).

ATM link. A virtual path link (VPL) or a virtual channel link (VCL).

B

Broadcast. A value of the service attribute “communication configuration”, which denotes unidirectional distribution to all users.

BCM (Broadcast Manager). An IBM extension to LAN Emulation designed to limit the effects of broadcast frames

BUS (Broadcast and Unknown Server). A LAN emulation Service component responsible for the delivery of multicast and unknown unicast frames.

C

cell header. ATM layer protocol control information.

CBR (Constant Bit Rate). ATM Forum Service category in relation to traffic Management on ATM networks. Includes anything where a continuous stream of bits at a predefined constant rate is transported through the network.

cell loss priority. A control descriptor in each ATM cell header which indicates the relative importance of the cell. If set to zero it should not be discarded, if set to one it may be discarded.

CIP (Classical IP). An IETF standard for ATM-attached devices to communicate using IP.

CIPC (Classical IP Client). A classical IP component that represents users of the classical IP Subnet.

CAC (connection admission control). The set of actions taken by the network at the call setup phase (or during call re-negotiation phase) in order to establish whether a virtual channel/virtual path connection can be accepted or rejected (or a request for re-allocation can be accommodated). Routing is part of connection admission control actions.

congestion control. The set of actions taken to relieve congestion by limiting its spread and duration.

connection oriented. Communication where there is a connection provided between sender and receiver, which must be maintained for data to be transferred.

connectionless service. A service which allows the transfer of information between service users without the need for end-to-end call establishment procedures.

constant bit rate service. A type of telecommunication service characterized by a service bit rate specified by a constant value.

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E

ELAN (Emulated Local Area Network). A LAN segment implemented with IBM Technology.

ESI (End System Identifier). A - byte component of an ATM address.

F

FC LANE (Forum Compliant LAN Emulation). ATM Forum compliance rules.

FPGA (Field Programmable field array). Module on which logic functions can be programmed.

I

IBUS (Intelligent Broadcast Unknown Server). A LAN Emulation optimization designed to limit the scope of unknown unicast frames sent to the BUS

ICMP (Internet Control Message Protocol). A protocol for communicating control information over IP.

IEEE (Institute of Electrical and Electronic Engineers). An organization involved in establishing Local Area Network standards.

IETF (Internet Engineering task force). An organization that product Internet Specifications

Interim Local Management Interface (ILMI). The standard (part of the UNI specification) for management of ATM networks. ILMI uses the SNMP protocol and a special UNI MIB to provide full information on the ATM network.

IP (Internet Protocol). A widely-use network layer protocol specified by the IETF.

IPX (Internet Packet exchange). A network layer protocol that is frequently used by personal computer systems.

ISO (International Standard Organization). An organization that specifies International Communication Standards

isochronous. Literally “in the same time”. An isochronous bit stream is one that goes at a constant rate. The term isochronous is often used colloquially to mean “digitally encoded voice”. The term is not often used in the world of data communications but is a common term in the voice communications and engineering context.

J

JPEG (Joint Picture Experts Group). A Standard body defining image compression methods.

L

LANE or LE (LAN emulation). The service provided by an ATM network to allow it to emulate a conventional LAN. Permits existing LAN based applications to communicate over ATM without any change being required.

LEC (LAN Emulation Client). A LAN emulation component that represent users of the emulated LAN.

LECS (LAN Emulation Configuration Server). A LAN emulation service component the centralize and disseminates configuration data as LES address.

LES (LAN Emulation Server). A LAN emulation service component that resolves LAN destinations to ATM addresses.

LIS (Logical IP Subnet). An IP subnet implemented with ATM technology.

LLC (Logical Link Control). The top sublayer of the Data Link layer, which is layer 2 of the ISO model.

M

MAC (Medium Access Control). The bottom sublayer of the data link layer, which is layer 2 of the ISO model.

MIB (Management Information Base). A network management base supporting the monitoring and control of network elements.

MPEG (Motion Picture Experts Group). A Standard body defining compression techniques for motion pictures such as MPEG-1 and MPEG-2 NTSC.

MSS (Multiprotocol Switched Services). A component of IBM′s Switched Virtual Networking (SVN) framework.

MTU (Maximum Transmission Unit). The maximum amount of user data that can be transmitted as a single unit (frame) on a communication link.

multicast. Operation where a message is sent simultaneously to a number of stations. Similar to broadcast, in principle, but usually only to a subset of the total number of stations on a network.

multipoint-to-point connection. A multipoint-to-point connection consists of a simple tree topology considered as a root node connected to many leaves. A multipoint-to-point connection has zero bandwidth

from the root node to the leaf nodes and a non-zero return bandwidth from the leaf nodes to the root node.

multipoint-to-multipoint connection. A multipoint-to-multipoint is a collection of ATM VC or VP links and their associated endpoint nodes. Any information sent on the connection by a node is received by all of the other nodes. A receiving endpoint node cannot distinguish which other endpoint sent the information unless some higher layer information is present for the purpose.

N

network node interface. The interface between two ATM switches.

NTSC (National Television Standard Committee). Video resolution: 525 rows x 700 vertical lines, 29.97 frames per second, transmitted as {fields/frame. Used in US, Japan,parts of South Africa.

O

OSPF (Open Shortest Path first). A link-state routing protocol specified by the IETF. Link-state routing protocols scale better than vector-distance routing protocol as RIP.

P

packet. In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. Synonymous with *data frame*.

In ATM, “An information block identified by a label at layer 3 of the OSI reference model.”

PAL (Phase Alternation by Phase). Video resolution:625 rows x 700 vertical lines, 25 frames per second.

Standard used in most the world.

PCMCIA (Personal Computer Memory Card International Association). An association involved in establishing hardware standards that are often associated with miniaturized peripherals.

PVC (Permanent Virtual Circuit). A logical connection between end stations, defined through administrator configuration, that is established at all times that the network is operational.

physical layer. In the Open Systems Interconnection reference model, the layer that provides the mechanical, electrical, functional, and procedural means to establish, maintain, and release physical connections over the transmission medium.

point-to-multipoint connection. A point-to-multipoint connection is a collection of associated ATM VC or VP links and associated endpoint nodes, with the following properties:

1. One ATM link, called the root link, serves as the root in a simple tree topology. When the root node sends information, all of the remaining nodes on the connection, called leaf nodes, receive copies of the information.
2. Each of the leaf nodes on the connection can send information directly to the root node. The root node cannot distinguish which leaf node is sending the information without additional (higher layer) information.
3. Leaf nodes cannot communicate directly with each other.

ATM Forum Phase 1 signaling does not support traffic sent from a leaf to the root.

point-to-point connection. A connection that has only two end points.

port. (1) An access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. Synonymous with *socket*.

private network to network interface. The interface between two switches, or between a switch and a switching subsystem. Also known as the private network to node interface.

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (2) In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. (3) A specification for the format and relative timing of information exchanged between communicating parties.

protocol data unit (PDU). A unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

R

RIP (Routing Information Protocol). A vector-distance routing protocol.Versions of RIP are used with IP and IPX.

S

SAP (Service Advertising Protocol). An IPX protocol used to advertise the location of available services.

SECAM (Sequentielles Couleurs Avec Memoire). Video resolution: 625 rows X 700 lines, 25 frames per second.

Standard used in France and Russia.

SDU (Service Data Unit). Data as it appears at the interface between a layer and the layer immediately above.

segment. A single ATM link or group of interconnected ATM links of an ATM connection.

signaling virtual channel. A virtual channel for transporting signaling information.

SLIP (Serial Line IP). An IETF Standard for running IP over serial line communication links.

SNA (System Network Architecture). A networking architecture developed by IBM currently used for large systems.

SNAP (SubNetwork Attachment Point). An LLC header extension that identifies the protocol type of a frame.

SNMP (Simple Network Management Protocol). An IETF Standard protocol that uses MIBs to control and monitor network elements.

SR (Source Routing). A bridging protocol for Token-Ring LANs.

SRT (Source Routing Transparent). A bridging protocol for LANs specified in the IEEE 802.1d Standard. SRT bridges support both source-route and transparent bridging on the same port.

SR-TB (Source Route Transparent Bridge). A bridge that connect SR and SRT ports

Sublayer. A logical sub-division of a layer.

switched connection. A connection established by signaling.

SVC (switched virtual circuit). A logical (not physical) connection established between two ATM stations on demand using signalling.

SVN (Switched Virtual Networking). The name of IBM′s framework for building and managing switch-based networks.

synchronous. Literally “locked together”. When two bit streams are said to be synchronous it is meant that they are controlled by the same clock and are in the same phase.

T

TB (Transparent bridging). A bridging protocol for LANs specified in the IEEE 802.1d Standard.

TLV (Type/length/value). A generalized information element that may be present in certain LAN emulation packets.

telephone twisted pair. One or more twisted pairs of copper wire in the unshielded voice-grade cable commonly used to connect a telephone to its wall jack. Also referred to as “unshielded twisted pair”

U

UBR (Unspecified Bit Rate). ATM Forum Service category in relation to traffic Management on ATM networks. The UBR service is for ″best effort″ delivery of data.

UTP (unshielded twisted pair). See *telephone twisted pair*.

UNI (User to Network Interface). The connection that links a user device to an ATM switch, hence attaches it to the ATM network.

V

VC (Virtual Channel). A concept used to describe unidirectional transport of ATM cells associated by a common unique identifier value.

VCC (Virtual Channel Connection). A concatenation of virtual channel links that extends between two points where the adaptation layer is accessed.

VCI (Virtual Channel Identifier). The VPI/VCI pair uniquely identify a specific ATM connection on a given link.

virtual channel link. A means of unidirectional transport of ATM cells between a point where a virtual channel identifier value is assigned and the point where that value is translated or removed.

VLAN (Virtual Local Area Network). A logical collection of ATM stations grouped into a single domain, and independent of physical location. A VLAN is often based on end stations having common access to a LAN emulation server or Classical IP ARP server.

VP (Virtual Path). A concept used to describe the unidirectional transport of ATM cells belonging to virtual channels that are associated by a common identifier value.

virtual path connection. A concatenation of virtual path links that extends between the point where the

virtual channel identifier values are assigned and the point where those values are translated or removed.

VPI (Virtual Path Identifier). The VPI/VCI pair uniquely identify a specific ATM connection on a given link.

virtual path link. The group of virtual channel links, identified by a common value of the virtual path identifier, between the point where the VPI value is assigned and the point where the VPI value is translated or removed.

virtual path switch. A network element that connects VPLs. It translates VPI (not VCI) values and is directed by control plane functions. It relays the cells of the VP.

virtual path terminator. A system that unbundles the VCs of a VP for independent processing of each VC.

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List of Abbreviations

AAL	ATM adaptation layer
ABR	available bit rate
A-CPSW	ATM control point and switch
AIX	advanced interactive executive
APPN	advanced peer-to-peer networking
ARE	all routes explorer
ARP	address resolution protocol
ASCII	American (National) Standard Code for Information Interchange
ATM	asynchronous transfer mode
AUI	attachment unit interface
B-ISDN	Broadband ISDN
BOOTP	boot protocol (IP)
Bps	bytes per second
bps	bits per second
BRI	basic rate interface
BUS	broadcast and unknown server
CAC	call admission control
CAD	common ATM datamover
CAP	common ATM processor
CBR	constant bit rate
CCITT	Comite Consultatif International Telegraphique et Telephonique (International Telegraph and Telephone Consultative Committee) now ITU-T
CE	circuit emulation
CIP	classical IP
CLP	cell loss priority
CPCS	common part convergence sublayer
CRC	cyclic redundancy check
CSMA/CD	carrier sense multiple access with collision detection
DAAT	destination address association table
DE	discard eligibility
DXI	data exchange interface
ECC	error correction code
EFCI	Explicit Forward Congestion Control
ELID	emulated LAN identifier
EMC	electromagnetic compatibility
ETSI	European Telecommunication Standards Institute
FCS	frame check sequence
FDDI	fiber distributed data interface
FPGA	field programmable gate array
FTP	file transfer protocol
Gbps	gigabits per second
GFC	generic flow control
HDLC	high-level data link control
HDTV	high-definition tele-video
HEC	header error check
IBM	International Business Machines Corporation
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IISP	interim inter-switch signaling protocol
ILMI	interim local management interface
INARP	inverse address resolution protocol
IP	internet protocol
IPX	Internetwork Packet eXchange
ISA	industry standard architecture
ISDN	integrated services digital network
ISO	International Organization for Standardization
ITSO	International Technical Support Organization
ITU-T	International Telecommunication Union - Telecommunication
KB	kilobyte
Kbps	kilobits per second
LAA	locally administered address

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LAN local area network

LE LAN emulation

LEC LAN emulation client

LECS LAN emulation client/server

LES LAN emulation server

LIS logical IP subnetwork

LLC logical link control

LNNI LAN emulation network node interface

LPDU logical link control protocol data unit

LSU link state update

LUNI LAN emulation user-to-network interface

MAC medium access control

MAT mamangement application transporter

MB megabytes

Mbps megabits per second

MIB management information base

MPOA multiprotocol over ATM

MSS Multiprotocol Switched Services

MTU maximum transmission unit

NBBS Networking BroadBand Services

NDIS network driver interface specification

NetBIOS network basic input/output system

NIX network information exchange

NNI network-to-network interface network node interface

NSAP network service access point

NRB non reserved bandwidth

OC-n optical carrier level n

ODI open data-link interface

OID originator identifier

OSI open systems interconnection

OSPF open shortest path first

PC personal computer

PCR Peak Cell Rate

PCI peripheral component interconnect

PCM pulse code modulation

PDH plesiochronous digital hierarchy

PDU protocol data unit

PG peer group

PGI peer group identifier

PGL peer group leader

PIM product independent module

PNNI private network node interface

PSM product specific module

PT payload type

PTSP PNNI topology state packet

PVC permanent virtual circuit

PVP permanent virtual path

QoS quality of service

RB reserved bandwidth

RIP routing information protocol

RISC reduced instruction set computer/cycles

RMON remote monitor

SAAL signaling ATM adaptation layer

SAAT source address association table

SAP service access point

SAR segmentation and reassembly

SDH synchronous digital hierarchy

SDLC synchronous data link control

SDU service data unit

SFE specific front end

SNA Systems Network Architecture

SNAP subnetwork access protocol

SNMP simple network management protocol

SONET synchronous optical network

SRB single route broadcast

SRF specifically routed frame

SSCOP service-specific connection-oriented protocol

SSCS service-specific convergence sublayer

SSI switch to switch interface

STM synchronous transfer mode

STP shielded twisted pair

SVC switched virtual circuit

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SVN	switched virtual networking
TA	terminal adapter
TAXI	transparent asynchronous transmitter-receiver interface
TCP	transmission control protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TDM	time division multiplexing
TE	terminal equipment
TFTP	trivial file transfer protocol
TRS	topology and route selection
TP	twisted pair (Wiring)
UAA	universally administered address
UBR	unspecified bit rate
UDP	user datagram protocol
UFC	universal feature card
ULEC	unknown LAN emulation client
UNI	user-to-network interface user node interface
UTP	unshielded twisted pair
VBR	variable bit rate
VC	virtual circuit (X.25) virtual connection (Frame Relay) virtual channel (ATM)
VCC	virtual circuit connection (X.25) virtual channel connection (ATM)
VCI	virtual channel identifier
VLAN	virtual LAN
VP	virtual path
VPC	virtual path connection
VPCI	virtual path connection identifier
VPI	virtual path identifier
WAN	wide area network

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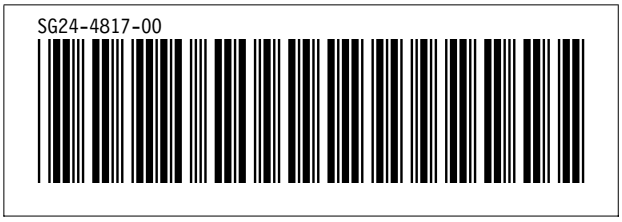
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